Engineering Library

IN TWO SECTIONS—SECTION ONE

JUL 2 1927

Engineering News-Record

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June 30, 1927

West Palm Beach Water Company Erects 20 M. G. D. Purification Plant

Constructing a Sixteen-Mile Levee on the Colorado Delta

Convicts Build Mountain Highway in Oklahoma

Rating Buildings for Liability to Earthquake Damage

Grouted Floor Construction, Clear Water Reservoir, West Palm Beach, Florida

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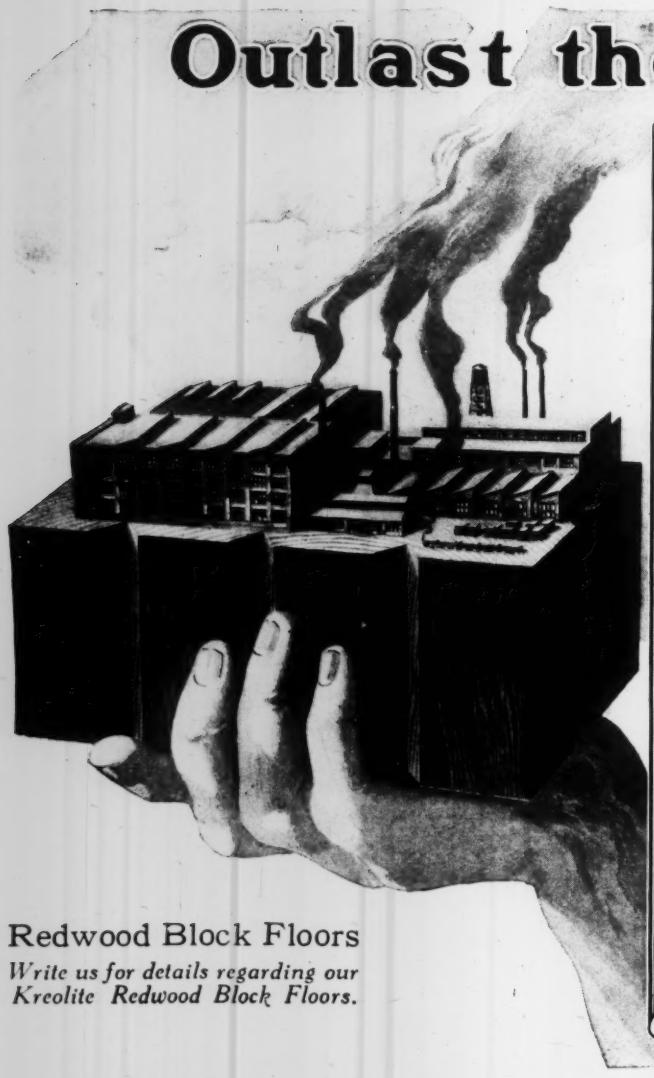

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

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John M. Goodell

THE great work of John Goodell, news of whose death has just reached me by cable, was the development of *Engineering Record* from a small though honored paper to a great and influential one. He accomplished this through that most valuable of editorial assets—a distinctive editorial idea. He did not imitate; he created a new conception, and that conception backed vigorously by Mr. McGraw made *Engineering Record* a publishing success and a great contribution to American engineering as well. His concept was that the constructor, requiring the application of high grade engineering no less than the designer, needed a generous literature. He set himself and his paper the task of gathering construction engineering data and experience in greater volume than ever attempted before. Also, since design and construction interact, he insisted upon the thorough treatment of design. Through this policy, *Engineering Record* strongly stimulated the development of sound construction practice.

Beyond this he set new and higher standards for American technical journalism and necessarily therefore improved the contribution which journalism makes to engineering. He had broad knowledge and a sympathetic contact with every branch of civil engineering. He was accurate to a fault. He was a good teacher. Happy were those who came under his severe but fruitful tutorship. He won confidence readily—an invaluable asset for an editor. One knew at once that John Goodell could be trusted. His great fault was overwork. He made a permanent impression on technical journalism and therefore on engineering by quickening the pace of development.—E. J. MEHREN.

Engineering Diplomacy

WITH the announcement from Washington that L. M. Lawson, an engineer of long experience in Mexican boundary conditions, has been chosen as a member of the International Boundary Commission, there is evidence that the value of engineering knowledge in dealing with complex groups of facts of engineering character is being appreciated even by the diplomatic and legal mind. Geographical conditions along the Rio Grande are not simple, in view of the shifting river channel. They urgently require adjustment, but not merely one that looks at past facts. The solution reached must be one which takes account equally of future developments and lays down principles which will determine the question in a feasible and mutually satisfactory way regardless of what may come about. By enlisting an engineer in the work and especially one of the peculiar abilities which Mr. Lawson has demonstrated in his work on the Rio Grande reclamation project, the State Department has served the country well. There is a genuine place in diplomacy for the engineering type of mind.

A Sharp Angle

A NEW angle in the Wanaque aqueduct controversy, and a rather sharp one, has been presented. After having granted a request of the contracting municipalities to submit the differences of technical opinion—which the summary elsewhere in this issue shows to be many and serious—to an engineer, mutually agreed on, and after having received a declination from that engineer to serve, the North Jersey Water Supply Commission has ruled out the other three names submitted by the municipalities, as stated in our news section, and informed the municipalities that it has decided upon a man not on their list. As the contracting municipalities have to pay for the work, whichever plan is adopted, and as its cost is one of the main points in controversy, it will be strange if the contracting municipalities do not make a strong protest today, when, the commission has notified them, it expects formally to appoint the engineer it has selected.

Another Large Manager City

THE large majority for the city manager plan in the referendum vote at Indianapolis on June 15 not only adds another large city to those that have already adopted the plan, but will also encourage any of its supporters throughout the country who may feel that the progress of the movement has been slackening of late. Possible recent occasion for this feeling was the defeat of the plan within a few weeks at Atlanta, Ga., and at Charleston, S. C., in both cases by large majorities. The conservatism of the South may go far toward accounting for these two defeats. The majority in favor of the plan at Indianapolis was more marked than the adverse majority in the two cities, as the figures given in our news section show. This majority was presumably due to a long and well conducted campaign coupled with much dissatisfaction with the sort of city government that has prevailed in that city for some time past. The handwriting on the wall seems to have been seen by politicians in control of the city and of the state as evidenced by recent blanket legislation providing that all city officials in the state should serve out their terms regardless of any change in the plan of their government. Thus the manager plan at Indianapolis will not go into effect until Jan. 1, 1930. Indianapolis makes the fifth city with a population of upwards of 300,000 that has adopted the manager plan within the past few years, its predecessors, in order of their population by the census of 1920, being Cleveland, Cincinnati, Kansas City, and Rochester. Comparatively recent defeats of the plan in cities of more than 300,000 population are those at Minneapolis and Seattle, but in each case the proposed charter was far from conforming to what has become pretty well recognized as the standard commission manager plan.

Water Power in Politics

MAKING political capital out of water power continues to be widespread throughout the country. Attention was drawn to this fact in the report of the Water Power Development Committee at the recent National Electric Light Association convention in Atlantic City. Fortunately, little actual legislation detrimental to water power development was passed during the past year but much needed work is being held up by political jockeying. The Tennessee River exemplifies this condition. Aside from the disgraceful display of governmental inefficiency in determining upon a policy for Muscle Shoals, there is every indication that political manoeuvering will indefinitely postpone the construction of other power plants or of storage reservoirs on the headwaters which are required to increase the prime power at Muscle Shoals as well as present and future plants. Similar conditions may be found throughout the entire country. This is not a cheerful prospect. If we are to keep up the yearly average of new water power projects brought into service, nearly 500,000 hp. each year since 1910, every possible power site, especially the important ones on the larger rivers, must be made available for development.

Montreal Typhoid Mystery

A SHERLOCK HOLMES is needed at Montreal. We cannot conceive of any other city on the North American Continent that would have let a typhoid epidemic of such proportions as has been raging in Montreal since March 3, not calling in a Sherlock Holmes in the form of the most accomplished epidemiologist, with an ample staff of sanitary engineers and other technical experts, to determine why such an epidemic could ever have begun, much less continued for 17 weeks. The menace of this outbreak is by no means confined to Montreal or to Quebec or to the Dominion of Canada. It extends throughout the United States and other countries of the world, diminishing only with distance.

Silver Cups for Safety First

CONTRACTORS who until recently have lagged behind other industrial employer groups in accident prevention are becoming active and characteristically they are introducing competition as a spur to speed. Silver cups are to be competed for. One cup is to go to the contracting organization showing the best record and the other is to go for the same reason to one of the chapters, of which there are now upward of a hundred, of the Associated General Contractors. The precise terms of the prize contest are given in the news section of this issue. Wisely, they have not been cluttered with conditions or restrictions. Any contractor who is a member of the association and any chapter of the association can compete. It will be an inauspicious event if many do not compete. Except the construction division of the National Safety Council, kept functioning by the yoeman service for nearly a decade of a few constructors, there has been no nation-wide espousal by contractors of accident prevention until this year when the Associated General Contractors undertook a purposeful campaign of promotion and organization. There have been individual contracting firms which did much and in Milwaukee, Detroit and a few other localities the leading contractors have joined in group activities in accident prevention. Indeed, it was the success of these local movements which largely inspired the country-wide movement inaugurated by the A. G. C. in January by the appointment, when the funds in prospect were small and the tasks in sight were many, of a director of accident prevention work. Then followed the gift to the association of $5,000 in commemoration of W. E. Wood and the donation of the prize cups now being formally offered. This is a good beginning, but it remains only a gesture until the membership does real work in organizing for both individual and group accident-prevention campaigns. Sharp competition for the prize cups will be the most encouraging indication that the management of the Associated General Contractors can have that its safety work is justifying its cost.

Enter, A New Age

WITH the completion of 25 years of active and fruitful existence, the American Society for Testing Materials celebrates its quarter centenary under peculiarly happy auspices. It looks back on a period of notable performance, developed from an idea whose full potentialities could not have been foreseen even by its originators. Ahead there lies a prospect of even fuller and more effective work differing in character from that of the past, just as industry today differs in its methods and motives from that of former years. A new age enters on the scene, an age of increased promise. The change is of deep significance, less for what it means to the society than for the fundamental transformation in industrial methods which it implies.

Contemplation of the growth state of such an organization carries the observer into certain focal regions of modern industrial life. It is to be remembered that the American Society for Testing Materials is our largest and most influential standardization society. Through its functioning, important current problems of adjusting industry to the demands of national life are being worked out. Each of the manifold items of specifications-making or auxiliary study is one element of this adjustment; and each item, whether trivial or large in itself, brings about a meeting of the minds of the various contending factions concerned in industry. Through such meeting of minds there is brought about a progressive improvement in efficiency, harmony and quality of industrial technology. The society's standardization work thus becomes a constructive factor of progress.

The result is not measured by the commercial value of the standards themselves. The actual outcome may be nothing more than some statements relating to five-hundredths sulphur, or 12 per cent absorption measured at 25 deg.—mere formal attempts to define the already current good craftsmanship in material making. Such definition does not lack value, but there is greater value in the activity lying back of it. In order to formulate the definitions, industry which serves is brought together with its clients and beneficiaries, without whom it cannot live. The opposite elements of industry, component parts of the same great mechanism, are here brought into conscious and willing co-operation.

Participation by industry in discussions of quality and specification-making is not a new phase of the society's work, but has been present from the start. Yet there is change from the condition of former years, when the parties engaged in the discussion were two sharply distinct classes, steel maker and engineer, for

example. Today, the discussions are between producing industry and using industry, equally powerful interests but equally sober-minded in trying to seek the best adjustment of their joint problem.

In this new alignment of forces, an outstanding feature is the part played by industrial groups—those remarkable bodies often called trade associations. A count shows that more than 100 such groups are at work within the American Society for Testing Materials alone. Representing not one maker or user but an entire guild, they serve to crystallize many scattered components into unit organisms. Whether, as some believe, the trade association will be the pilot of the future's commercial development, or whether the trade represents only a transition toward some other form of co-operative effort, it has already shown that industry need not attempt to lift itself by the boot straps, but can find strength in co-operation. And in this connection it is of much interest to note that where industrial groups engage in standardization, they are not merely defending their interests or helping incidentally in solving a problem of adjustment, but also, through the very necessities of the case, are entering into investigative research that means progress for their technology. Such relations between industry and standardization as are fostered by the society's activities, therefore, result in giving powerful impetus to research within industry, one of the outstanding developments of the present era.

The gradual evolution of its work thus tends to make the American Society for Testing Materials a forum for self-standardization. A recent movement, but one of great promise, it will influence profoundly the coming years of the society's existence. Just as industry itself is entering a new period, one marked by far-reaching internal and inter-industrial co-operation, and the development of group research on a large scale, so the society also is entering a new age. Its productive possibilities, we believe, will prove to be no less important than those realized in its first quarter century.

A Financial Matter

BY A coincidence we are able to present this week an outline of studies concerned with the financial aspect of earthquake protection, following the discussion of structural earthquake problems last week in describing the Mitsui Bank framing. The two articles in conjunction give a plain picture of the intimate involvement of engineering and financial problems in the earthquake question.

Money talks. It is apt to talk quite plainly when insurance is its mouthpiece, because of the large sums at risk and the peculiar element of hazard that is inseparable from insurance. Earthquake protection has for this reason become a subject of genuine interest on the Coast recently. The Santa Barbara earthquake, with its damaging effect on buildings of many different types, made earthquake insurance popular, and underwriters faced the task of appraising the degree of risk if they desired to avoid dangerous speculation.

The very crux of the earthquake-protection problem lies in the questions that grow out of such insurance. If the chance of sudden, widespread, loss in an earthquake is definite, a building owner faces the prospect of ruin at any moment, unless he protects himself by adopting earthquake-resistant construction or by insuring. If he merely insures, a properly fixed rate of insurance would be prohibitively large unless his building is of earthquake-resistant construction. Thus, if the risk is properly appraised, the effect of insurance will be to improve building practice by compelling owners to adopt more resistant construction.

The earthquake-risk appraisal described by E. W. Bannister is therefore potentially of far-reaching importance for the building practice of the Pacific Coast. It is the first systematic attempt, so far as we know, to make a careful analytical appraisal of such risk for an entire class of buildings. The procedure followed was based on the assumption of a rather long-time probability, namely, that a shock of first magnitude may occur at any time. Such shocks are likely to be far between on the coast as a whole, and still rarer at any single point; but there is obvious warrant for the assumption in the fact that the risk is concentrated—an insurance company with any appreciable coverage in one city would constantly be on the verge of bankruptcy, since any day might sweep away its whole reserve by a destructive earth shock. Underwriters could hardly expect to collect enough excess premium in the seismic interval to enable them to pay such a loss. The peculiar character of insurance against general catastrophe, in other words, justifies a pessimistic view of damage possibilities. Correspondingly, the appraisal of a building as to its resistance in an earthquake must be rigid; if anything it is bound to discount the credits for points of good construction and emphasize the debits for this or that weakness—overhanging cornice, irregular ground plan or deficiency in lateral bracing.

Extensive and steadily continued improvement in fire-resistant construction of buildings followed upon the spread of fire insurance. Similarly we may expect the study of earthquake hazard to bring about financial appreciation of the value of good construction, and thus to result in improved practice. There are indications that this process has already begun, as a result of the reluctance of insurane companies to take large amounts of earthquake risk on a single building.

The building owner who seeks to cover himself, may feel wronged by such reluctance, but the underwriter is fully justified by his fears. Necessarily, the building owner must reduce the severity of the risk by adopting better building construction, and thereby enabling the insurance company to take the remaining risk.

Present knowledge of earthquake possibilities is hazy in the extreme. It is impossible to speak of a statistical basis of earthquake expectation as yet, and in view of the slow rate at which data are being accumulated the outlook for better knowledge is not very encouraging. Under these circumstances it is reasonable to conclude that in a region which has a recognizable earthquake hazard—though of an amount which cannot be estimated quantitatively—the building owner should protect himself, at the price of moderate increase in first cost, by incorporating a substantial measure of earthquake resistance in his building.

The engineering problems of such protective construction are not yet fully solved, but their study has begun. It is certain even now that a large degree of protection can be provided by good construction, without inordinate increase of cost. But in this matter, as in most others, engineering waits on finance. When the investor quite generally comes to demand better construction, the engineering problems will become tangible and will be solved.

West Palm Beach Water Co. Builds 20-M.G.D. Purification and Pumping Plant in Ten Months

Portion of Site Located in Lake Bed Excavated and Diked by Electric Dredge After Which Water Pumped to Lake, Ground Water Lowered and Bottom Dried Out by Pumping from Wells

BY CHARLES F. RUFF
Assistant Engineer, Hazen & Whipple, New York City

THE phenomenal growth of the neighboring cities of Palm Beach and West Palm Beach for the past few years has necessitated a corresponding increase in all the utilities. In 1921 the communities were adequately served with water by a 3-m.g.d. filtration plant. In the winter of 1924-5 an additional 3-m.g.d. unit, then just completed, failed to meet the peak demand of 7 m.g.d., the additional 1 m.g.d. being supplied from wells. The winter of 1925-26, with a peak demand of nearly 9 m.g.d., which taxed the filters and wells to their limit, showed that increased facilities were needed at once. The city of West Palm Beach accordingly granted an increase in water rates, which enabled the privately owned West Palm Beach Water Co. to build a new plant. In view of the rate of growth outlined above, and the prospect of serving areas of the city previously supplied from small wells, a 20-m.g.d. plant was decided upon. The decision was made in January, 1926. Provision was made to bring the ultimate future capacity to 40 m.g.d. by duplicating the filters and placing additional pumps in the station. How the plant was designed, built, and put into operation by the end of the same year, or within ten months, is here described.

Site—The only available site for the new works was the bottom of Clear Lake, immediately west of the old plant. The new filters, effluent aerator, pure water reservoir and pumping station were all built to the west (or lake side) of the old bulkhead (Fig. 2). Two coagulation basins which had been begun in 1925 were located north of the old plant on what had been a sawgrass swamp. The portion of the lake covered by the new works varied in depth from 2 to 6 ft. The bottom was fine white sand, covered from 6 to 12 in. with black muck, a product of decayed vegetation. Eighty to 90 ft. below is a layer of relatively coarse shell, and it is from this stratum that the well water was pumped.

Available to fill the land needed for the plant, the water company owned and operated a 12-in. electric dredge. The pumping station and pure water reservoir were designed to rest on or below the original lake bot-

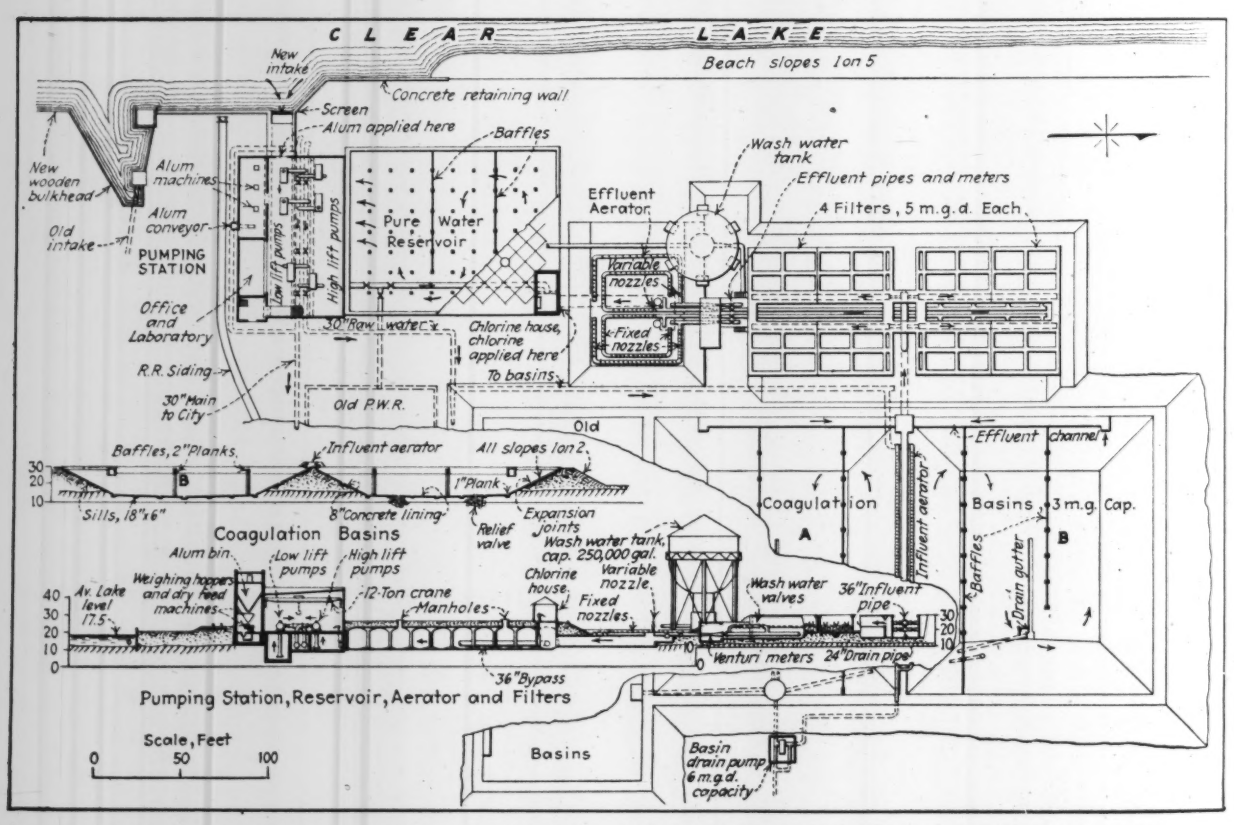


FIG. 1—GENERAL PLAN AND SECTIONS OF NEW WATER TREATMENT PLANT FOR WEST PALM BEACH, FLA.

tom, from 9 to 17 ft. below lake level. The filters and effluent aerator were placed on newly filled land, and so designed that a slight settlement would do no damage. The dredge was floated to the site and used to excavate for the deeper structures, pumping and placing the material to make fill on which to build the shallower structures.

Handling Ground Water—The problem of unwatering this excavation was considered from several angles.

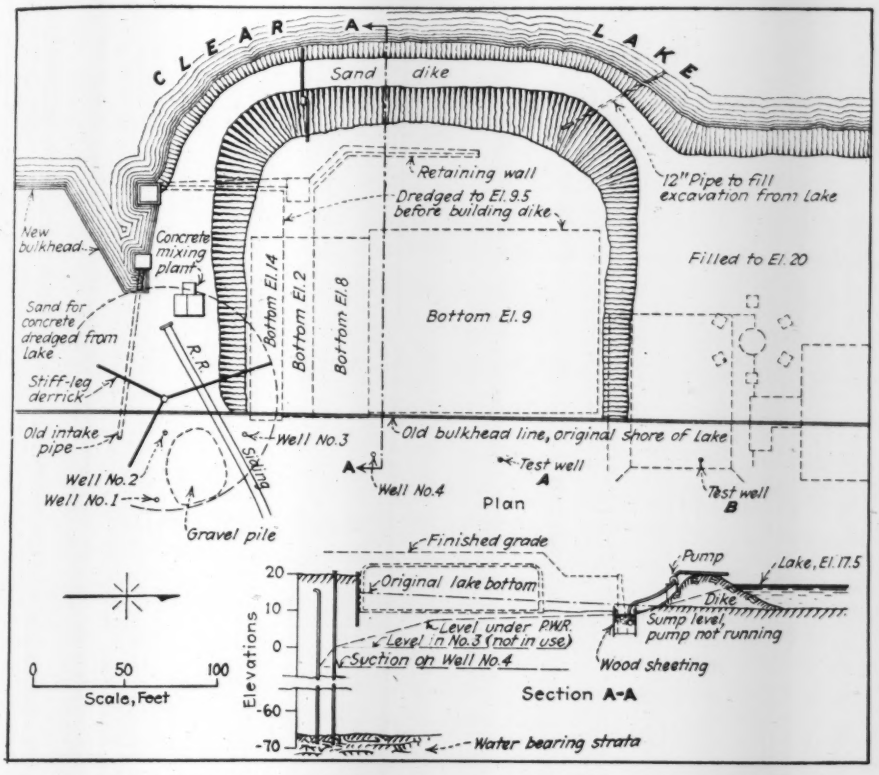


FIG. 2—DEWATERING CONSTRUCTION LAYOUT FOR WATER TREATMENT WORKS

Various methods of surrounding the excavation with sheeting or cofferdams were suggested, but it was doubtful if the hole could be successfully unwatered on account of the nature of the sand. This sand was very fine, and previous experience showed that under a ground water head of only 4 or 5 ft. it became unstable, causing a quicksand condition. This would necessitate pouring the bottom slabs under water, through tremies or otherwise, before the excavation could be pumped out. Before resorting to this, a method of lowering the ground water level was sought.

At this time the wells were being used for water supply only in the day time, and shut down at night. Two test wells, *A* and *B*, Fig. 2, consisting of 20-ft. lengths of 2-in. pipe, were jetted down. After several days of continuous pumping on the wells, the ground water at *A* had dropped to 6 ft. below lake level, at *B* about 4 ft. below. The effect of this pumping was also noticeable on the ground water level in basin *A*.

From these experiments it was decided that, if sufficient water could be pumped from the shell stratum below the lake, the ground water would be lowered enough to permit unwatering the excavation. The well system was therefore overhauled and the well pump lowered.

Three wells, No. 1, 8-in., No. 2, 13-in., and No. 4, 6-in., were connected to the electric-driven centrifugal pump, and delivered 2½ m.g.d. with 25-in. vacuum. No. 3 well, 8-in., was equipped with an air lift and a steam-driven compressor was purchased to supply air for this and additional wells if it should prove necessary No new wells were needed, and this well was used only as a standby when the electric current was off. All the wells were open at the bottom without strainers.

The dike around the site of the work was built by the dredge. It was 30 ft. wide at lake level, with slopes approximately 1 on 2. A 12-in. pipe, with a valve in it, was placed through the dike below lake level. It was realized that if for any reason the well pump should be out of service long enough to let the ground water rise above the bottom of the excavation it might cause damage and settlement to any structures built on the bottom. This pipe was to allow the excavation to be filled from the lake before such a condition could occur.

As soon as the dike was closed in, the water inside commenced to lower, reaching a maximum of about 2 feet. below the lake. At this point leakage through the dike equaled the water drawn out through the bottom by the wells. A 6-in. centrifugal pump was then installed and the rest of the water pumped out. It was necessary to use this pump to handle the leakage through the dike, but no water entered the excavation from the bottom. Water was even observed flowing out of the dike and a short way across the bottom where it soaked in again. The leakage through the dike rapidly lessened as the black muck referred to above sealed it up, and after the first few weeks an ordinary gas-driven double diaphragm pump was able to handle this seepage. Toward the end of the job this pump was run for only a short time every day. The bottom under the pumping station, at El. 8, 10 ft. below lake level, was solid enough to permit the final excavation to be done with mule scrapers. The cost of excavation and fill, building the dike and subsequently removing it, as done by the dredge, was about $15,000. This compares very favorably with the originally estimated cost of $52,500 for the use of sheetpiling. Pumping costs are not included in either of the above figures, but were probably higher for the well-pump system. However, a third to a half of this water was used to supply the city, and would have been pumped in any case.

The section in Fig. 2 shows average ground water conditions throughout the job. The line of ground water levels shows the point at which the sand was wet, but not necessarily the ground water pressures. The sand being nearly impervious relative to the waterbear-

ing shell strata, the water flowed through it nearly vertically downward. The ground water pressure in the lower strata was therefore lower than the upper ground water level by the friction loss in flowing through the sand. Lowering the ground water level to the condition shown required some time, the bottom getting perceptibly drier for a period of several weeks after continuous pumping was started. When the well pump was out of service for several days, the water level rose at the rate of 10 in. per 24 hr. until the air lift wells were started.

Coagulation Basins—Two coagulation basins, begun in 1925, were finished along with the 1926 additions. These basins were designed to hold 1½ m.g. each, and to handle, with 8 hr. retention, a total of 9 m.g.d. The basins, 140x160ft. and 14 ft. deep, are open, with round-the-end baffles. The walls are sand dikes, 6 ft. wide at the top, with 1 on 2 slopes. The site, originally a swamp, was stripped to clean sand with a dragline excavator. Sand was then pumped on the site to El. 21. The inside was dug out to El. 13 and the banks piled up to El. 30 by the use of mule scrapers. Before placing the concrete lining the banks were consolidated by filling each basin. This was done from the bottom, through the drain pipes, the water being allowed to rise to El. 27.3, or 14 ft. above the bottom of the other basin, which was empty. Water was left in for 24 hr., the water absorbed by the banks during this time amounting to a 36½-in. drop. No water showed outside, but a small flow developed through the division wall into the other basin. Due to loading and saturating the banks before placing the concrete, the latter, when placed and the basin filled, had an average settlement of ¼ in. and a maximum of ½ in.

The concrete lining of sides and bottoms was of 8-in. unreinforced slabs, about 13 ft. square. At the joints each slab rested on a 6x12-in. concrete sill, the top of which was coated with tar. Expansion was provided for by placing a 1x8-in. board between the slabs. Slabs were poured alternately, the boards serving as forms for the first series and being left in place when the second series was poured. Although it was found possible to pour 1 on 2 side slopes with very dry concrete and no top form, a movable form 3 ft. wide and loaded with sand bags was used.

To prevent the ground water from raising the bottom slabs when the basin is emptied for cleaning, six relief valves were provided in each basin. These consist of a bed of graded gravel placed under the floor with a pipe leading up through the slab inside the basin. This permits the ground water pressure to escape, without causing a large enough flow to interfere with cleaning. Flap valves prevent water from leaking out when the basin is full. The baffles were of 2x8-in. yellow pine, supported by concrete columns every 15 ft. The top 2 ft. of baffle was made of concrete, as wood might rot.

The basin lining, when first filled, was not entirely watertight. After a month's use, when the floc from coagulation had had a chance to soak into the joints, the leakage was only ⅜-in. drop in 24 hr. Of this, ⅛ in. was evaporation and the remaining ¼ in. represents a leakage of 3,000 gal. per day.

Filter—Four filters of 5-m.g.d. capacity each were built. Due to the limited capacity of the wash water pipes and drain lines each filter was divided into four compartments for washing. These compartments are washed successively in one operation, the whole filter being out of service for about 20 min. at each washing. The rate of wash is regulated by a Venturi controller, and the amount of wash water recorded on a chart. A vertical rise of 18 in. per min. is generally used, at which rate the sand expands about 20 per cent. The effective size of the filter sand used was 0.41 mm.; uniformity coefficient, 1.53. As originally furnished the sand was too fine, having an effective size of 0.31 mm. This was corrected by placing the sand in the bed, washing it, and removing the requisite amount from the top. Tests showed that, after washing, the sand at any level was very uniform. The uniformity coefficient for any layer ranged from 1.25 to 1.30 in the top 15 inches.

The filters were built of reinforced concrete, with perforated pipe underdrains, and presented no unusual difficulty in design or construction. Each pair of boxes was built as a separate self-contained unit, making eight in all, to allow for unequal settlement. Walls were

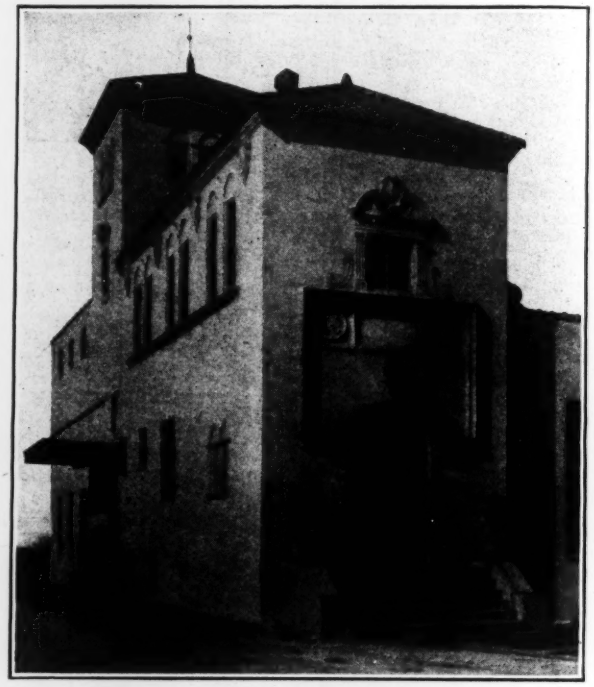


FIG. 3—MAIN ENTRANCE TO PUMPING STATION

poured monolithic for each unit and ¼x4-in. steel plate was placed at the wall and floor joint to prevent leakage. After filling, the filters were found to be practically watertight. Settlement of the different units caused the joints between some of them to open as much as ⅛ in., but this was provided for. No filter house of any sort was provided, the mild climate permitting outdoor operation through the year. After leaving the filters, the water is again aerated before passing to the pure water reservoir. The aerator basin is 81x79 ft. and 6 ft. deep, similar in construction to the coagulation basins.

Wash Water Tank—A new steel wash water tank of 0.25 m.g. capacity was built to supplement the existing tank. The foundations of this tank were designed for a load of 1½ tons per square foot. Two legs of the tank stand in the effluent aeration basin, are therefore longer and have deeper foundations. After these deeper piers were poured and the hole backfilled, it was found that they had settled 3 in. under their own weight. The

higher piers did not settle perceptibly. The explanation for this appears to be that the new fill was still in a semi-plastic condition, that digging the hole for the pier took enough weight off the bottom to allow it to rise a short distance, aided by the flow of water. When the pier was poured and backfilled the bottom was pushed back to its original level. It was also thought possible that some material had been squeezed into the excavation for the pure water reservoir. For this reason the tank was not filled until all structures were built and backfilled, and the sand around the tank confined. When finally filled, all piers settled uniformly ¾ in. The Pittsburgh-Des Moines Steel Co. was contractor on tank.

Pure Water Reservoir—The new pure water reservoir is 120x96 ft. and 10 ft. deep, with a capacity of 0.8 m.g.

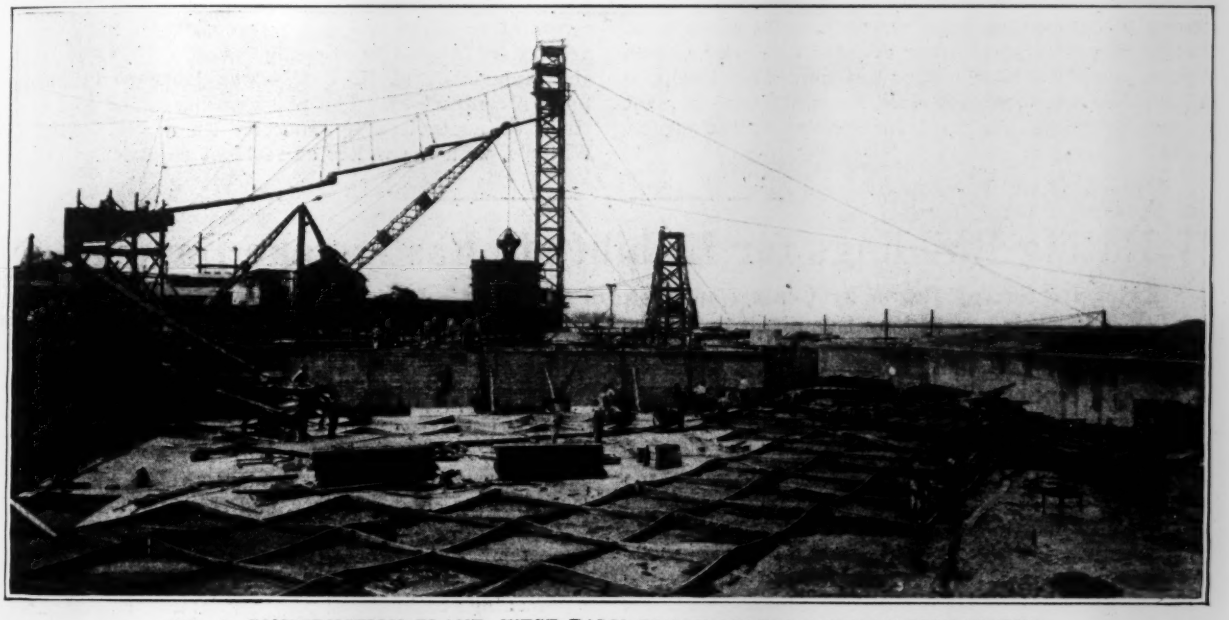


FIG. 4—CONSTRUCTION PLANT, WEST PALM BEACH WATER PURIFICATION WORKS

The roof and floor are of the groined arch type, with columns spaced 12 ft. c. to c. each way. The reservoir, as designed, was liable to float under a ground water head equal to lake level, and is held down by 4 ft. of sand fill on top. During construction, before this fill was placed, it was very important to prevent this ground water pressure from raising the floor. The well pump was the main reliance. On one occasion this was broken down for several days, but the air-lift well was able to hold the water down until the electric pump was back in service. On another occasion, during the July hurricane, the waves broke through the dike and let in the lake. The water rose inside and outside the reservoir at the same time, a hole having been left in the wall for this purpose, and no damage was done. When the time came to remove the dike this hole was grouted up and the reservoir filled from the filters, while at the same time water from the lake was admitted to the excavation outside the reservoir through the 12-in. pipe provided. The dike was then dredged away, some of the material being used for the fill on top of the reservoir.

Pumping Station—On account of the uncertain foundations, the pumping station was built in two self-contained units, side by side. One of these contained the office, laboratory, switchroom and alum storage and handling apparatus. The other was the main pump room. These two structures were offset from each other, so that any crack between them would occur in a re-entrant angle. The load on the pump room foundation was 0.7 tons per square foot and under the alum bins 1.2 tons. The station (Fig. 3), is built entirely of reinforced concrete, with stucco outside and stone trim.

Due to the operation of the well pump no water trouble was experienced. The only sheeting used was for the low-lift intake chamber. This sheeting was 3x8-in. yellow pine, tongued-and-grooved. It was jetted to place before any excavation was done, which permitted the sheeting to be closely fitted and placed accurately to line, so that it was used as the outside form for the concrete walls. Compared to the effect of driven sheeting, the sand outside was relatively undisturbed and had less tendency to flow through the sheeting or exert pressure on it. Excavation for this chamber was done with a ½-yd. clamshell mounted on a truck. As the excavation proceeded the sheeting was braced every 2 ft. At the level of the bottom of the chamber, 15½ ft. below lake level, no more water was encountered than could be handled by the 4-in. diaphragm pump. The bottom of the rest of the station, as well as the pure water reservoir, was so dry it had to be sprinkled with a hose before placing concrete on it.

Six centrifugal pumps were installed in the pump room: a 3-, 7- and 15-m.g.d. high-lift pump, and the same capacities in low-lift pumps. Suction piping was cut to a minimum, each pump drawing from a suction chamber under the floor. The low-lift suction chamber extends to the lake with screens provided at the intake, and concrete wing walls to hold back the sand. The high-lift suction chamber is next to the pure water reservoir and connected to it by four 4x2-ft. sluice gates. Between the two is the discharge pipe gallery. All the pumps are driven by 4,200-volt synchronous motors with direct-connected exciters. Tests of these units showed over-all efficiencies from 74.5 per cent for the 3-m.g.d. high-lift to 78.8 per cent for the

15-m.g.d. high-lift. All efficiencies were above those guaranteed. The pumps and switchboard were installed by the Turbine Equipment Co. The old pumping station is available as a standby.

Construction Plant—The construction plant is shown by Fig. 4. Concrete for the pumping station and pure water reservoir, which comprised the bulk of the yardage, was made at a central mixing plant. A stiff-leg derrick with 75-ft. boom and clamshell bucket was used to unload the gravel from the cars to the storage pile and to the charging hoppers. All the sand used for concrete was supplied by the dredge. Although this sand was finer than is generally considered good for concrete sand, it was, after being pumped by the dredge, unusually clean. Tests showed that cylinders made with this sand had about 90 per cent of the strength of cylinders made with Ottawa sand, and by a slight increase in cement the same strength could be secured. Saving was effected in using dredged lake sand at 30c. a yard, compared to $3 a yard for coarser sand shipped in, with more cement. Besides the main mixing plant a portable mixer was used for concreting the basins, filter and aerator.

Costs—Final costs, including engineering and contingencies, and interest during construction, were:

Filters	$178,000
Effluent aerator	36,000
Pure water reservoir	61,000
Pumping station, including alum storage bins and feeding apparatus and laboratory	334,000
Wash water tank (including considerable pipe line)	40,000
Coagulation basins	202,000
Grading, planting grass, miscellaneous	26,000
	$877,000

Rapid completion of the work was due to the Turner Construction Co. which had the general contract. The contract was let on a cost-plus basis, and the actual cost was nearly 10 per cent below the original estimate. At the time the contract was let conditions in Florida were more or less uncertain; material was scarce and prices high due to the railroad embargo and labor was hard to secure. The Turner Construction Co.'s estimate was lower than any lump-sum bid which could have been received at the time and under this contract the owners profited by the improved conditions of 1926, as to labor and materials. E. K. Dewey was job superintendent for the contractors. The plant was designed and construction supervised by Malcolm Pirnie, of Hazen & Whipple, with the writer as resident engineer.

Rating Buildings for Liability to Earthquake Damage

Extensive Survey Begun by Coast Underwriters After Santa Barbara Earthquake—Buildings Inspected and Plans Examined to Estimate Effect of Earth Shock of No. 8 Intensity

By Edward W. Bannister
Consulting Engineer, Board of Fire Underwriters of the Pacific, Los Angeles, Calif.

THE EARTHQUAKE at Santa Barbara on June 29, 1925, recalled public attention to the fact, long known to scientists, that the western coast of the United States is peculiarly liable to seismic action, and that such manifestations might be expected at irregular intervals. The amount of destruction, while principally due to deficient construction, showed conclusively the possibilities in more thickly settled areas. Measures tending toward the reduction of hazard by all preventable means were universally adopted by governing bodies, and insurance underwriters became so strongly interested in the subject that they attempted a rating survey.

Insurance companies had almost universally accepted liability covering damage by earthquakes at low premium cost. The return, however, was inadequate as compared with the risk involved; and while the amount of insurance in force on Santa Barbara risks was not excessive, the management of companies accepting such liability realized that the disaster formed an object lesson in possibilities of loss in other localities, where earthquake insurance coverage was more general. The potential loss was recognized as reaching alarming proportions.

A Preliminary Survey—In order to allow companies to write such insurance more intelligently and to acquire some knowledge of the actual physical condition of the structures already insured, instructions were issued by the earthquake committee of the Board of Fire Underwriters of the Pacific to institute an examination of about 125 selected risks located in and about the city of Los Angeles. Tentative forms were printed, giving particular attention to foundations and character of excavation, together with materials and methods of construction, structural deficiencies apparent on visual inspection, and other pertinent items. A force of competent inspectors was organized under the supervision of the writer as chief engineer, and the work was rapidly accomplished. The results were deemed satisfactory by the committee, particularly on account of a supplementary summary, not included in the original form, giving a percentage estimate of possible damage as compared with the original cost. This—although simply a personal opinion of the writer, formed after perusal of the inspector's report and a necessarily casual inspection of the risk—proved to be the most interesting feature of the report to those authorizing the examination, on account of affording a working basis, even though necessarily approximate, by which to judge the desirability of the risk from the insurer's standpoint, and the possible amount of loss.

Comprehensive Inspection Instituted—Authorization for extension of work, covering the cities of San Francisco, Oakland, Los Angeles and San Diego, but restricted to insured structures of fire-resistive construction, was immediately given.

As it was realized the estimates of possible damage based entirely on personal opinion were both inaccurate and incapable of demonstration, means of fixing the measure of damageability by definite calculations were studied. This was the more difficult on account of complete lack of precedent. Still another feature, and one greatly influencing the character of the proposed work, was that it was desired to determine the possible financial loss in an earthquake of specified severity, rather than to produce a mere catalogue of structural deficiencies, although the two had an admitted correlation. It was apparent that buildings might be seemingly unhurt

after shock and yet, on account of large distortion during earthquake strain, be almost completely wrecked as to their interior finish, partitions and equipment, with possible heavy damage to exterior walls and facing, necessitating more or less complete replacement and constituting a practically total loss.

It was finally decided to segregate the percentage costs of the component parts of each structure. Various buildings were detailed and the cost of their components ascertained, and the final averages were checked by structural engineers and architects. From these figures was compiled the operating schedule Table I, which formed the basis of all examinations.

Assumed Standard Earthquake—Some definite assumption was necessary as to earthquake strength, or rate of acceleration to be expected. After considering the 1906 shock in California, the 1923 shock in Japan and the Santa Barbara disaster, it was found that the acceleration in solid rock ranged from 2 ft. per sec.[2] in San Francisco to 3 ft. in Japan, and that the rate for filled ground varied from 10 ft. in San Francisco to 16 ft. in Tokyo. Such maximum accelerations would cause practically complete destruction, but the chance of their occurrence was considered remote. For the present purpose an average condition, which might represent a reasonably severe shock, was assumed: a horizontal acceleration of 3 ft. per sec.[2], approximately $g/11$, representing an intensity of 8 on the Rossi-Forel scale.

Inspection—A complete visual examination was made by an inspector, who noted all apparent deficiencies, interior and exterior, together with description of construction, ornamentation, character of excavation and foundation, presence of tanks on roof, chimneys or stacks, etc., attaching sketches of roof plan and vertical section. A list of all items required by report but not possible to obtain by such inspection, together with a copy of structural plans or information where they could be obtained, was attached.

Plan Examination—Inspectors' reports, when checked by the section chief, were passed to plan examiners, whose first duty was to supply all missing information. The structural plan of the building was then considered as regards its ability to withstand lateral forces, and conclusions were noted. All calculations were made in blank books provided for the purpose, insuring a complete record capable of check or revision. Upon completion, and notation of results on a form sheet, the report was returned to the chief examiner for final grading.

All buildings to be examined were divided into four classifications—office, store or loft, hotel or apartment, and warehouse. Garages and theaters were placed in the loft and office classifications respectively. Each variety of structure was again classified as to frame, whether structural steel or reinforced concrete, and percentages of cost assigned to integral parts as per Table I.

The percentage charges to be assessed against each item were based on the assumption that the foundation is in firm soil. More serious conditions, such as filled ground or alluvial soil, were recognized by the automatic raise of grading to the next more serious classification. The percentages were used as decimal parts of the percentages assigned each construction item. Thus, quoting schedule instructions, for Foundations, "If column footings are isolated, or not interconnected by basement floor of reinforced concrete 6 in., or plain concrete 12 in., in thickness, located not over 5 ft. above top of footings, 50 per cent." The charge against foundations of an office building, if footings were found to be isolated, would be 50 per cent of the 5 per cent original cost, or 2½ per cent of original cost of building.

Percentage charges not only were assessed against defective foundation design and construction but included also the following list of conditions considered liable to cause partial damage or complete failure:

TABLE I—COST PERCENTAGES OF DIFFERENT BUILDING TYPES AS USED IN EARTHQUAKE RISK SURVEY

Components of Structure	Percentages of Total Cost: Office Building		Store or Loft		Hotel or Apartment		Warehouse	
	R.C.	S.	R.C.	S.	R.C.	S.	R.C	S.
Segregation	5	5	7	7	5	5	9	9
Foundations	...	10	...	18	...	10	...	25
Structural steel frame	...	8	...	15	...	8	...	20
Floors and roof	18	...	33	...	18	...	45	...
Frame, floor and roof	12	12	8	8	10	10	9	9
Walls, including exterior ornamentation	2	2	...	...	4	4	...	...
Partitions	40	40	24	24	40	40	15	15
Trim and finish								
Equipment including plumbing, heating, ventilating, electrical work, but excluding elevators	13	13	16	16	17	17	10	10
Elevators	10	10	12	12	6	6	12	12
Total	100	100	100	100	100	100	100	100

R.C. means reinforced-concrete frame.
S means steel frame.

Frame — Columns non-continuous; excessive floor openings; columns overloaded; use of bearing walls; use of cast-iron columns; floor construction inadequate for occupancy; spandrel construction inadequate; tanks on roof; beam or floor steel non-continuous or not hooked; design not calculated to withstand lateral stress.

Exterior Walls—Curtain walls, whether supported by frame or self sustaining; filler wall construction; bearing wall construction.

Finish and Equipment — Total percentage charge calculated as applicable to frame, floors and roof was charged to each item.

Damage by Falling Walls—Classified under such heads as one or two-panel building with (a) two overhanging walls, (b) one overhanging wall; three, four or five-panel building, similarly; and building of more than five panels.

The charges were used both for steel and reinforced-concrete frames, but in addition an arbitrary percentage was assessed against all concrete buildings on account of uncertainty of construction, and the total charges were increased if supervision of such construction was found to be inadequate. Particular attention was given to the investigation of the character of such supervision, and all construction was penalized unless records showed full-time inspection by competent men.

Calculation Sheet—The total tabulated charges, as shown for a typical case in Table II, automatically determined the grading of the building. The table shows the possible charges against an office building, with the percentages of original cost assigned to a structure of this type in the first column. Opposite each segregated percentage is the estimated percentage of damageability, built up from fixed charges in the schedule. It will be noted that the percentage charge against "Frame, floors and roof" is also assessed against each of the following items, with the exception of "Exterior walls." This was deemed equitable, as it was considered only logical to assume that if the frame, floors and roof were damaged to any fixed degree the interior partitions, trim, finish, equipment and elevators could not but suffer proportionately. The total of the

third column is naturally the arithmetical sum of all percentage charges, and the resultant "Severe" grading is defined by the following classification.

Term	*Per Cent of Damage*
Excessive	Above 80 per cent
Severe	60–80 per cent
Serious	40–60 per cent
Moderate	25–40 per cent
Slight	15–25 per cent
Minimum	Below 15 per cent

Examination of the reverse side of the calculation sheet shows the makeup of the governing charge, i.e., that assessed against frame, floors and roof, and related

TABLE II—FACE AND REVERSE OF CALCULATION SHEET COVERING TYPICAL REPORT

City S. F. File No M-1
Name of Bldg BOFU HOTEL
Street Address 99 Market St.
Class A Type F

Segregation	Per Cent of Total Cost		Per Cent of Damage
Foundations	5	50	2.50
Steel Frame			
Floors and Roof			
Frame, Floors and Roof	18	65	11.70
Exterior Walls	10	100	10.
Partitions	4	65	2.60
Trim and Finish	40	65	26.
Equipment	17	65	11.05
Elevators	6	65	3.90
Total	100		67.75

Remarks

SEVERE

21 Story Steel Frame.
Brick filler walls on S.& E. below 9th floor. Balance T.C.Curtain. Concr. to 2nd on S. Steel and brick to 8th on E.

Ext. Orn.Heavy T.C. on N. & W. for full height and on S. & E. above 9th.

Int. Orn. Excessive in lobby. Im. marble and plaster. Same in dining room on 21st floor. Balance not excessive.

Dim.Plan - Unsatisfactory. L shape and too high for breadth.

Weak connections	10
Lateral Stress	25
Col.axes wrong	3
Ext.cols.non-cont.	8
Int.cols.non-cont.	10
Floors overloaded	5
Steel not hooked	1
Tanks on roof	3
	65

items. The various amounts of percentage charge were fixed by the chief examiner, after inspection of inspector's report and plan examiner's findings, being proportioned between maximum and minimum in accordance with the conditions found. The charge marked "Lateral stress" is the amount of deficiency chargeable against the design, found directly from the report of the plan examiner. A quotation from the instructions may serve to show the method used:

> (c) *If design is not calculated to withstand lateral stress.* Consider under this heading the following pertinent items, and estimate (basing estimate on ratio between strength of connections or members and destructive forces) the percentage of stability. Percentages shall range as follows: ¼ or less; ½; ¾; ⅞ or more. Notes showing calculation of such percentage *must* be kept in book furnished for purpose. Consider further: Longitudinal bracing; cross bracing, particularly as to absence of or deficient cross bracing; inadequate connections, particularly as from non-continuous columns to girders, cast-iron columns to adjacent members, connection of composite construction (column to column, column to girder, etc.); column splices; column axes faced in one direction; column length between supports; use of cast-iron bases for columns; inadequate design of principal members.

Examiners determined the horizontal forces acting in any direction and at any point of each building under consideration by making a calculation of the weight of the structure and contents above any given point and substituting values in the usual formula. Lateral forces were thus found for any story of the structure, and distribution made at the respective panel points of the frame. Knowing these shears in any story, the reaction on the footings was determined by adding each increment. With all horizontal forces known, the distribution throughout the frame and the resistance of the structure to a given force were calculated. It was usually necessary to investigate only the first and second stories. Horizontal shears are a maximum there, and the majority of buildings are constructed with large first-story heights and resulting long moment arms on columns, producing maximum stresses at connections of the second floor system. In cases, however, all stories, members and connections were considered.

Study of the form of connections between columns and adjacent members was early recognized as a controlling feature. The so-called "Standard" connection, even though accompanied by top and bottom angles, affords little resistance to lateral stress. Gussets of adequate size are an improvement, but it is difficult to secure a sufficiently stiffened frame without the use of diagonals. These, in turn, are objectionable from the standpoint of the architect; but it must be realized that unless the frame is strong enough to move as a unit, structural damage is inevitable.

Instructions covering all contingencies were formulated and issued to section chiefs, plan examiners and inspectors, and their compliance to these instructions was rigidly enforced. This was particularly necessary as regards plan examination. It was early recognized that the securing of structural plans, vital to the success of the operation, was going to be a difficult matter. Theoretically, complete plans of all important structures are supposed to be on file in the local building department. Actually, only a limited number are usually so found, making it imperative to obtain copies from the engineer or architect responsible for the work. As a few men of each profession in every community perform the larger part of high-class construction, considerable annoyance may be caused by examination of their records. Friction, however, was prevented almost entirely by strict adherence to regulations and by the spirit of interest and co-operation of the Associated Architects and Engineers. Plans were secured for all but a minimum number of buildings being traced by various means and in some cases as far as New York City. Any structure for which no plans were obtainable was automatically given a "Serious" grading.

All risks graded "Serious," "Severe" or "Excessive" were marked with asterisk in order that insurers receiving application for coverage might know at once, in some degree, the relative condition of the risk. Lists of completed examinations were prepared at intervals, giving name and address of each structure together with Sanborn map data, and forwarded with summary sheets of each report to all companies interested.

Examination of buildings covering the cities of San Francisco, Oakland and the Bay District, San José, Santa Barbara, Los Angeles and vicinity, and San Diego, was completed Oct. 31, 1926, nine months after the commencement of major operations. The total number of structures examined was 2,721, resulting in 2,402 reports at a cost of $36,685.99, a unit cost of $15.27 per report. Provision was made by the board at the last annual meeting for further extension of the files, by the appointment of engineers in Los Angeles and San Francisco to examine more recent construction.

The utmost credit should be given to S. S. Gorman and J. E. Shield, chief examiners at San Francisco and Los Angeles respectively, to whose intelligent interest and thorough ability was due the success of the work.

Mussolini Heads Up Italy's Productive Forces

By E. J. Mehren
Vice-President, McGraw-Hill Publishing Company, Inc.

Milan, Italy,
May 31, 1927

IN A previous article the present economic situation in Italy was described. This article will tell how the whole of Italy's productive forces are being federated, and will add some comment on the Italian situation as a whole.

In a famous address in the Scala Theater, in Milan, some years ago Mussolini thus epitomized his theory of government, "All within the State, nothing against the State, nothing outside the State." If the doctrine were to become more than abstract theory, industry was bound sooner or later to receive the Duce's attention. Its turn came last year. The result has been the federation of all producers—and not merely industry—into three great "unions," one for the employers, one for the employees, and one for the professional classes. The merchants and the bankers necessary to the productive function are also included. The entire organization heads up in the cabinet, in a "ministry of corporations," and at present Mussolini holds that portfolio among his many others. Thus there heads up in him the whole productive and distributive mechanism of the peninsular kingdom—the industrial and agricultural employers, the merchants and the banks; the employees, industrial, agricultural and commercial; lastly, the professional classes.

The Plan—Under the ministry of corporations come the three great unions of confederations: the union of confederations of employers and the similar union of employees—both have six constituent confederations—for industry, agriculture, commerce, maritime and aerial transportation, land and internal-waterway transport, and banking. Each of these confederations, in turn, is made of national syndicates of important industries, resembling our industrial and trade associations. For example, the Confederation of Industry has six constituent syndicates, namely, for chemicals, silk, cotton, the mechanical industries, the metallurgical industries, and miscellaneous industries. The land and internal waterways confederation is divided into four groups: railroads, motor transport, internal navigation, miscellaneous agencies. Up to the present the organization of professional people has not been completed, but it is to have three confederations—of professional men, of artists and of artisans. Under the professional confederation are to be syndicates of chemists, of engineers, of agricultural specialists and of a miscellaneous group. In order that all interested in one line of industry, trade or agriculture may come together there is also a cross liaison, through a group of "corporations," in which employer, employee and technical group syndicates may get together.

In all these unions, confederations and syndicates, the directing officials are appointed by the ministry, but selected from the group in question. In each provincial town, where the numbers warrant, there is also a secretary for each syndicate, and he appoints a committee that has charge of the activities of the syndicate branch in the province. Among the engineers, for example, the Associazione Nazionale Ingegneri, the former Italian national engineering society, has become by law the Sindacato Nazionale Ingegneri, and its officers are no longer elected by the members, but appointed by the ministry of corporations. Quite naturally the men prominent in such organizations before are prominent in the local branches now. Rome relies upon local advice largely for the selection of local secretaries and the make-up of the managing committees.

One of the provisions of the law governing these organizations is that there may be neither strikes nor lockouts. Mediation must be tried first; if that fails, the controversy goes to an arbitral body whose decree is final and binding. Neither after the decision nor during the proceedings may there be a cessation of work due to the efforts of either party. It is plain, therefore, that all productive forces of the country are under close control, and that an industrial, agricultural, commercial or banking policy decided upon in Rome can quickly be put into effect. This explains the present unanimity in the reduction of industrial wages. There is no law, but the word having gone out from Rome through the union of confederations of employers, the results are even swifter than could be accomplished by legislation, for the organization is active right down to the factory door and to the meeting room of the labor union. Under wise counsel on top it can be seen that such an organization is effective for just the sort of remaking that, by common consent here, Italy needed.

A Parliament of Producers—Aside from the administrative functions which naturally fall to the confederations and syndicates, Mussolini plans for his organization of producers a parliamentary function. He has announced that the present lower house of parliament, selected on a territorial basis, is to be discontinued and that in its stead will be a house made up of delegates from these confederations. The present session is to be the last of the old type of parliament. Presumably, the delegates to the new house will be appointed by the ministry, and not elected by the members of these bodies. The senate will remain as now. With the tight control on top this new house can be no more than advisory in character, or "approvative" one might say, but the scheme in theory is a recognition of the importance of the functional as against the territorial interests of the state.

Mussolini's Recent Speech—Reference was made in a previous article to an address made by Mussolini on the opening of parliament on May 26. Probably the most striking features of the address appeared promptly in the American press. But certain points will bear repeating. The address had been awaited for some time, for the Premier makes fewer speeches now than formerly. It was a report on the "state of the nation" as we would call it. It was somewhat of the "sword-rattling" variety, but was calculated to continue his work of increasing Italian national consciousness and pride. Probably his most interesting statement was that he still had from 10 to 15 years of work ahead. He used the words, "for my successor has not yet been born." That remark, though, is interpreted here to

mean that his successor will be such a young man that he is not yet in political life. In any event, he gave clear notice that he has no present intention of relinquishing his leadership. On the political side, he was caustic regarding the "evaporation" of the Locarno spirit, claiming that the nations there assembled were again in an armament race. Here he rattled the sword. Italy must be in a position to make itself felt when the crucial time of arms comes; between 1935 and 1940 she would be in a position to assert her standing. The democratic idea had been a delusion, he declared, and the Fascisti were now celebrating its burial.

He pointed out that Italy in 1950 would, at the present rate of increase, have a population of 60,000,000, which must be provided for by land development and industrial growth. Since population is a factor in military strength, the growth should be assisted by assistance to mothers and children, the funds coming from taxation on unmarried people and childless couples. He condemned municipal ownership of utilities, which is in harmony with his action of selling the telephone system of Italy to private interests some years ago. He did not believe in prohibition, but the Italians drank too freely and 25,000 cafés would be closed. Finally, he predicted that in 10 years one would not recognize Italy for she would have changed fundamentally her countenance and her soul. It was a spirited address, well calculated to fan to brighter flame the everywhere evident Italian patriotism and to strengthen Italian confidence. It was defiant in part; it was a firm reiteration of Fascism's determination to go right forward on its present policy of organizing everything for and within the state.

Some General Comment—One cannot but form some idea as to the wisdom of the régime as a whole. One cannot expect people that one meets for only an hour to enter into a full and frank discussion of the subject. The Fascists themselves make no secret of the quick way in which they deal with opposition; "nothing against the state" is the doctrine. What one sees and hears, then, are the surface things. Outwardly everything looks well. The country is prosperous; the people look and dress well, and appear confident. There is no doubt that the method works, and when one expresses doubt as to its wisdom the answer comes quickly that no other régime would have been adequate for Italy's needs at the time; and this statement is made with evident conviction by men of affairs. It is, of course, recognized here that Mussolini's method and his governmental theory run counter to the convictions of the Western world, but always there is the statement that Italy needed a strong control.

In Switzerland, three weeks ago, a Swiss gentleman who knows Italy well made the statement that if Mussolini remains in power for 15 years Italy will retain the organization he is creating and will continue strong and healthy, but that if he is taken off within five years there will be a disorder, and retrogression. The new organization, this observer maintained, is not yet a matured mechanism, the future leaders are not yet trained, the new patriotism and spirit of sacrifice are not yet of the soul of Italy. Given 15 years all this will have been done. An interesting and sagacious judgment it was, in the light of Mussolini's own words of last Thursday, that he has 10 or 15 years more of work ahead. If he remains in control, Italy is sure for the next decade to be one of the world's interesting social studies. Today, outside of Italy, there is general criticism of his methods. What, though, may come out of his organization of a nation along functional rather than territorial lines?

Loyalties are commonly believed to attach themselves to the soil; hence territorial representation in government. But is the idea sound? Is America a series of land parcels or a spirit, an ensemble of ideas, aspirations, principles? Certainly that which determines our well-being and our social outlook today is largely the occupation in which we are engaged. Is Mussolini's conception more in harmony with present day industrialism than is territorial representation? Be it recalled that a chamber of commerce advisory to our Congress was long ago suggested. In Germany there is the Reichswirtschaftsrat—a council of representatives of employers, employees and the public which must report to the Reichstag on all economic legislation proposed in that body. In England we have the Labor Party—an effort to get functional representation in government. Again, the pulling and hauling—the lobbying—of labor and of capital in our own Congressional and legislative corridors is but another evidence of the demand of the functions of society for recognition.

Has Mussolini hit on something that will be adopted into industrialized countries in the future? Obviously, his experiment would be more significant if the new house of parliament were freely selected and had liberty of action. Nevertheless, there is here an idea of importance—a deliberate adoption into government of functional representation, and a more thorough one than the German experiment. Despite its limitations it is worth watching.

Finally, one can readily believe, after a brief visit, that if Mussolini runs Italy for 10 years more, it will have a new countenance and a new soul. What will come then no one can tell; possibly disorder, possibly gradual and peaceable re-democratization.

Railway Electrification in India

Projects for both suburban and main-line electrification on Indian railways are noted in the 1926 report of the Railway Board. The Bombay suburban service of the Great Indian Peninsula Ry., now in operation as far as Bandra, will be supplemented by extending the electrification on the main line and suburban tracks to Kalyan and then on the two diverging main lines to Igatpuri and Poona. Electrification of suburban service on the Bombay, Baroda & Central India Ry. from Bombay to Borivli is planned, in connection with a new terminal station. At Calcutta, the project of electrification of the suburban service has been revived as a result of the decision to build a new cutoff line, around the city, with a bridge over the Hooghly River at Bally. At Madras, the South Indian Ry. is building additional tracks for its suburban service as far as Tambaram, and electrification is planned in view of the development of hydro-electric power supply in the vicinity. The government of India has engaged Merz & McClellan as consulting engineers to investigate both the hydro-electric and railway electrification projects of Madras and Calcutta.

Almost Complete Utilization of Small Pennsylvania Stream

Mining Conditions Lead to High Storage Giving Average Safe Yield of 0.9 M.G.D. per Square Mile of Drainage Area

By Farley Gannett
Of Gannett, Seelye & Fleming Engineers, Inc., Harrisburg, Pa.

THIS STORY relates to the South Branch of Roaring Creek, a small but important stream in the anthracite coal region of Eastern Pennsylvania, and the practically complete utilization of its average runoff for municipal supply, coal mining and other industrial purposes in Shamokin and vicinity. The total storage provided on 12.2 sq.mi. of drainage area is 1,965 m.g., or 161 m.g. per sq.mi. After deducting 1 sq.mi. for reasons stated below, it is believed that an average safe yield of 11 m.g.d., or 0.9 m.g.d. per sq.mi., can be obtained from the drainage area with the storage now available. The high degree of utilization of this stream is an illustration of how the conservation of one natural resource sometimes makes possible the full utilization of another; or in this case, how water is conserved to make possible a continuation of coal mining which would otherwise be impeded.

The growth of coal mining in the section under consideration has been accompanied by a corresponding growth of cities and villages, and also in the demand for water for municipal and industrial use, the latter including immense quantities for coal washeries and boiler plants. At the same time the character of the water supplies, especially for municipal purposes, has been threatened by the mining operations. Thus, in the early days of anthracite mining, only the larger sizes of coal were marketed. The rejected smaller sizes, from buckwheat down, together with other wastes, were piled up into mountains of culm and rock, in many cases lining the streams with débris from source to mouth. From these black mountains spring floods wash masses of culm and other wastes into the streams. To these are added the fine coal, sand and shale from the breakers and washers. As a result most of the streams in the anthracite coal measures have been ruined except as carriers of waste.

Under such conditions, the coal towns and industries are often at their wit's end to find suitable water supplies and are sometimes forced to go outside the coal mining areas for water. This is the case at Shamokin and vicinity, where the South Branch of Roaring Creek, just outside the coal measures, is drawn upon by three companies to supply Shamokin and other towns, coal mines and industries. The Roaring Creek Water Co. and the Bear Gap Water Co., which are affiliated, supply the lower part of the district and the Wyoming Valley Water Supply Co. the upper and lesser portion, which includes several coal mines and small mining towns. This company supplements its reservoir by two drilled wells. The supply of the Roaring Creek Water Co. goes to Shamokin and adjoining communities, a large part of it, of late, being sold to the Eagle Silk Co., which has a large factory in Shamokin. This is an all gravity supply, while the others are pumped. The Bear Gap Water Co. operates a high level pumping system, mostly for the benefit of coal companies, but it also wholesales water to two or three other companies, which supply Mount Carmel and Marion Heights.

Until the drought of 1922 and 1923, the 665-m.g. storage afforded by the three reservoirs owned by two of these companies provided all needed storage to supply the consumption, which was then 6 m.g.d. The drought led to the construction of a 1,300-m.g. reservoir by the Roaring Creek Water Co., bringing the total storage up to 1,965 m.g. This trebling of the storage, it was thought, would nearly double the safe yield, bringing the latter up to 11 m.g.d., which it was assumed would be sufficient until 1957, making allowance for the recent rate of growth of water demand. But no sooner were the new dam and reservoir completed than the large silk mill in Shamokin applied for all the water that could be spared, thus nearly exhausting in two months a margin thought sufficient for 30 years. The present consumption supplied by the three companies is about as follows: Bear Gap, 2.2 m.g.d.; Roaring Creek, 6.5; Wyoming Valley, 1; total, 9.7 m.g.d. This leaves only 1 m.g.d. of safe margin.

The assumption of a safe yield of 11 m.g.d. from the South Branch of Roaring Creek is based on the following data: With a drainage area of 12.2 sq.mi. stretching for nearly 12 mi. between two parallel ridges about 1 mi. apart, and considering many studies of similar streams in this high precipitation region of Pennsylvania (about 48-in. average rainfall), the average runoff subject to collection in reservoirs is put at 300 m.g.d. in very dry years. Eliminating 1 sq.mi. of drainage area above the upper dam leaves 11.2 sq.mi. of drainage area, which at 300 m.g.d. per sq.mi. would provide 3,350 m.g.d. a year. Substituting 4,000 m.g. as an average safe yield for the 11.2 sq.mi., 11 m.g.d. would result. Thus about 1,800 m.g. reservoir capacity would be required to store the yield of the average dry year or 2,200 to store the average runoff and carry water over from wet to dry years.

From the new and largest reservoir, two gravity mains, one of 16- and one of 18-in. cast-iron, lead to the city, a distance of nearly 10 mi. A mile from the city, the 18-in. line connects with two concrete equalizing tanks, built in 1924, which almost completely eliminate pressure fluctuations—formerly as much as 40 lb. from maximum day to minimum night demands.

The stream flows through a wooded sandstone valley, so the water is naturally pure, clear and soft. After the completion of each of the two larger reservoirs the water therein was somewhat discolored and gave off a little odor, due to decaying vegetable matter, although the sites had been thoroughly cleaned. This trouble continued during the first summer only. All water from both new reservoirs is chlorinated.

New Rubber Roadway in Use in London

Last year there was laid in New Bridge St., in London, England, which is a thoroughfare subjected to very heavy traffic, a section of 700 sq.yd. with a patented rubber block consisting of a 10⅜x5⅜-in. rubber cap vulcanized to a brick base. The foundation of the street is a 12-in. concrete base. Upon this, the rubber-capped blocks were laid on a sand bed and were jointed with a patented preparation owned by the manufacturer of the blocks. After the roadway was opened to traffic there was no movement of the blocks notwithstanding heavy traffic at varying loads and speeds day and night.

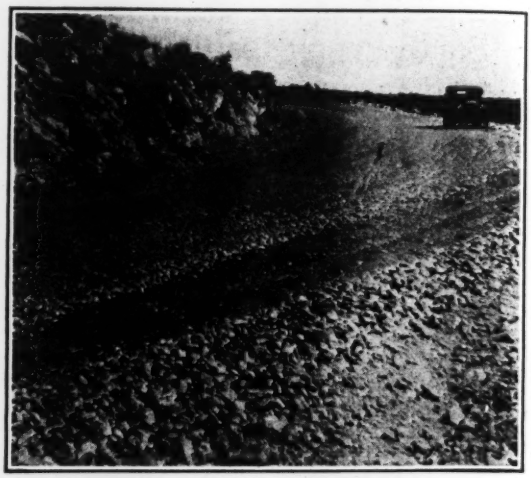
State Highway Developments of 1926 Awarded Blue Ribbon of Distinction by State Highway Engineers

SEVENTH ARTICLE

Convicts Construct a Mountain Highway

BY A. O. WALKER

Construction Engineer, State Highway Commission, Oklahoma City, Okla.



FINISHED CUT IN SOLID ROCK

THE Oklahoma State Highway Department is finishing a construction job across the Arbuckle Mountains in the southern part of the state that has been very unusual in its nature and in the methods employed in its construction. This work has been particularly interesting, due to the fact that it is Oklahoma's first successful attempt at using convict labor to build improved roads. The total length of the project is 15.1 miles, of which 7.7 miles are of unusually heavy construction through solid limestone formations. This route shortens the distance between Ardmore and Oklahoma City by 18 miles and passes by Turner Falls, which is one of the scenic spots of Oklahoma.

Character of Work and Quantities—From the south end of the project (station 0), north to the foot of the mountains (station 140), the land is rolling and the soil is sandy loam. The earth quantities were about 4,000 cu.yd. per mile and the work on this section was done with fresnos. From station 140, which is at an elevation of 953.16 ft., is a continual climb with a maximum grade of 5 per cent, to station 238, at an elevation of 1,255.6 ft. This is a side-hill location through solid limestone with a maximum cut of 22 ft. The rock formations on this section were very peculiar in that the strata set on an incline of about 45 deg. and from the surface appeared in rows extending 2 to 3 feet above the average ground level. From station 238 to station 400, across the summit of the mountains, the rock formations were very similar. However, the grading quantities were lighter and dirt was available for backfilling and finishing over a part of this section. From station 400, at an elevation of 1,130.03 ft., the road descends to station 547, to an elevation of 796.21 ft., which is the edge of the Washita River valley. This section is a side-hill location, through a limestone conglomerate formation, with a maximum grade of 5.26 per cent and cuts running to 47 ft. in depth. Between stations 547 and 792, the road crosses the Washita River valley. This is a fresno grading section running about 4,000 cu.yd. of earth embankment to the mile.

The drainage structures included in this project consisted of stone and concrete box culverts, none exceeding 16 ft. in span. The quantities are given in the table herewith.

Construction Force and Equipment—The construction force comprised 1 construction engineer, 1 instrument man, 2 foremen, 1 camp superintendent, 1 night watchman and 75 laborers (state convicts). The construction equipment included: Two 9 x 8-in. portable air compressors; one 5 x 5-in. portable air compressor; four jackhammers using 1-in. steel; one drill sharpener and furnace; 18 mule teams; 10 wheel scrapers; four 5-ft. fresnos; six 3-ft. fresnos; one 8-ft. grader; one concrete mixer (1-sack batch); two 1½-ton trucks; two 3-ton trucks; two 1-ton trucks; two cars for camp superintendent and construction engineer.

OKLAHOMA

THE HIGHWAY improvement described was a most difficult one to carry out with unskilled convict labor. Because of the nature of the rock strata lying as they do from almost perpendicular position to an angle of not greater than 45 deg. with the perpendicular, and because of the mountain location, the work presented some real problems, both from an engineering standpoint and from a construction standpoint. The road is constructed in every respect in accordance with standard requirements and will eventually be surfaced with some form of rigid pavement. Prior to its construction, there was no more than a trail crossing the Arbuckle Mountains and very few automobiles undertook the difficult passage, preferring to detour some eighteen miles to the east where the Arbuckles terminate. The project described is a section of what will constitute the main line of traffic between Kansas City, Oklahoma City, Dallas, Fort Worth, San Antonio, and all points in Southern Texas.—J. M. PAGE, *Former State Highway Engineer.*

QUANTITIES IN OKLAHOMA HIGHWAY CONSTRUCTION

Earth excavation	10,568 cu.yd.
Loose rock excavation	662 cu.yd.
Solid rock excavation	92,441 cu.yd.
Borrow	35,450 cu.yd.
Overhaul	57,077 cu.yd.
Class A concrete	865 cu.yd.
Stone masonry	744 cu.yd.
Reinforcing steel	57,651 lb.
24-in. concrete pipe	784 ft.
30-in. concrete pipe	172 ft.

Drilling and Blasting—Since most of the work was solid rock excavation and the progress of the job was largely controlled by the drilling and shooting, careful attention was given to that part of the work to keep it going at its best. The two 9 x 8-in. compressors were stationed about 400 ft. at right angles to and up-grade from the shooting. They were connected to a portable air storage tank which supplied four jackhammers through a 1½-in. pipe line. In this manner, the drilling was extended to about 1,400 ft. from the compressors, which was about the maximum distance the air could be piped without showing a loss in pressure and lowering the efficiency of the jackhammers. Thus a 2,000-ft. section of road was drilled at each set-up of the compressors by shifting the air line

CHARACTER OF ROCK EXPOSURE

along the roadway as needed. By using the storage tank and air line the compressors carried a steady load at all times and furnished a uniform air pressure to the jackhammers, giving much better results than when direct-connected.

Ten feet was the maximum depth the drilling was done at a time for the reason that over that depth the steel did not rotate freely and too much time was lost removing fastened bits. This made it necessary on deep cuts to drill, shoot and remove excavation for a depth of about 10 ft., then redrill the cut until the required grade was reached. On some of the heavy cuts it was necessary to repeat operations three and four times. When possible, each drill section was completed at one set-up of the compressors in order to avoid so many moves with the machines. By keeping the number of moves to a minimum, much better service was obtained from the equipment, and time was saved from building temporary roads and changing air lines.

The crew for drilling and shooting was: 1 acting foreman, 4 men on jackhammers, 3 men loading and shooting, 1 man attending compressors, and 1 man with wagon and team. This crew, including the acting foreman, were all convicts, none having any previous experience in this kind of work. The foreman, a life-term convict, took his orders from the construction engineer, attended to the duties the same as an employed foreman, and was responsible accordingly.

The cut and fill quantities balanced with less than 10 per cent of waste. Since there was no borrow available, it was necessary to do the shooting in such a manner as to leave all the excavated quantities in the roadway to be used in the fills and also to break it into sizes that could be handled with wheelers and fresnos. The drilling and shooting was done with this object in mind. However, these results were not completely obtained, for it was impossible to break all the ledges without some oversize being left. The oversize stone was handled with rock sleds along with the wheeler work, and the shooting results proved very satisfactory.

The drill holes were spaced as follows:

Depth	Spaced
2 ft.	2 ft.
4 ft.	3 ft.
6 ft.	4 ft.
8 ft.	5 ft.
10 ft.	6 ft.

The holes were loaded to within a foot of the top of the ground, and fired with a 150-shot electric battery. Pyrotol, a government war product, similar in effect to 40 per cent dynamite, was used on the south half of the job, and the balance of the work was done with 40 per cent dynamite. There were 13 cars of explosives used on this work and no accidents occurred.

Grading Organization and Methods—The grading crew and equipment consisted of two foremen; 32 men; 16 teams; 10 wheel scrapers; six 3-ft. fresnos; four 5-ft. fresnos; one No. 2 road plow; one No. 4 road plow; one 8-ft. grader, and rock sleds and small tools.

Immediately following the drilling gang, 1 foreman with 5 teams and about 12 men began removing the

BLUE HOLE LOOP IN ARBUCKLE HIGHWAY

oversize rock and placing them in the fills with rock sleds. As soon as this was accomplished, this crew followed the drill gang to the next cut, and the wheeler and fresno gang, consisting of 1 foreman, 11 teams and 20 men, followed. The work was started with fresnos and carried up to a haul of about 100 ft., then a wheeler run was started and the fresnos decreased as the haul increased. The wheelers loaded easier than the fresnos, did not spill so badly, and were easier on the men and teams. For these reasons they were used on as much of the work as possible.

As soon as the drilling gang had completed the first drilling on a section, the grading gang would usually have the other end graded and ready for the drilling gang again. In about two hours' time the pipe could be shifted and drilling resumed. Each section was completed in this manner, and it was seldom necessary for the drilling gang to move back to do any drilling after

they had left a section. All shooting was done at noon and evenings, thus not hindering the grading gangs during the day.

Culvert Construction—The culverts were built by a gang of twelve negro convicts with one acting as foreman. Two trucks were assigned to this work for hauling materials. From stations 0 to 400, the culverts were constructed of stone masonry walls and reinforced-concrete slab tops. Stone for the walls was taken from the roadway by the grading gangs and hauled on wagons to the culvert locations. Likewise, all stone for concrete was taken from the cuts and crushed on the job. Since the convicts were inexperienced in this kind of work, a simple plan was used for the culverts which required only a chalk line and straight-edge to lay out the work.

There was no stone available for masonry on the north part of the job and reinforced-concrete box culverts were used. This gang was unable to build forms satisfactory for concrete boxes and it was necessary to use a foreman on this part of the work. The average production per month was about 100 cu.yd. of concrete. From stations 440 to 465 the hillsides were steep and almost inaccessible. Much time and expense were saved by using reinforced-concrete pipe on this section. The pipe was hauled to the locations on a rock sled, sometimes requiring two teams to place one 4-ft. section of 24-in. pipe.

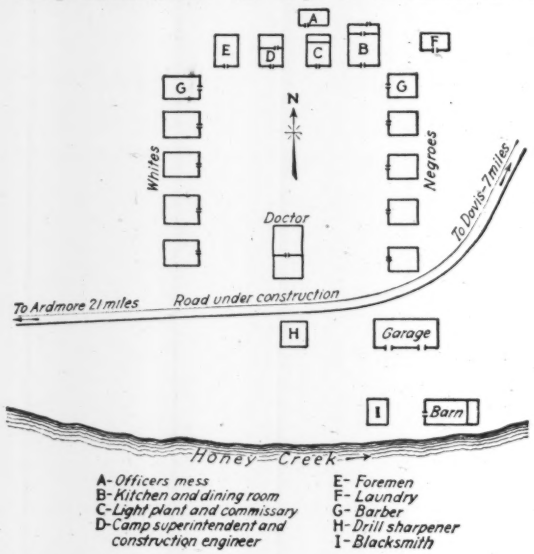
Convict-Camp and Job Management—The organization for convict work was:

In charge of camp	Camp Superintendent	
	Night watch	
In charge of construction	Construction Engineer	
	Instrument man	
	Two foremen	
Convicts on camp maintenance	1 commissary steward	
	1 camp porter	
	1 barber	
	2 laundrymen	
	2 cooks	
	2 kitchen helpers	
	1 doctor	
Total		10
Convicts on construction	2 stablemen	
	2 drill sharpeners	
	1 blacksmith	
	1 mechanic	
	2 truck drivers	
	12 men on culvert gang	
	10 men drilling and shooting	
	35 men on grading gangs	
Total		65

The convicts were selected from the first-class and trusty wards at the Oklahoma state penitentiary. None were taken except those with good prison records who desired to go, after it was explained what would be expected of them. These were made trusties, and assigned to the camp on their honor to obey the camp rules. The camp superintendent was employed by the state highway department. However, his selection was approved by the warden of the penitentiary. He was held responsible for the men by the warden, and likewise by the highway department for the purchase of camp supplies and the maintenance of the camp. The construction engineer was responsible for and had charge of the construction, including the shops, did all the purchasing of supplies relative to the construction, and was responsible for the men during the day. In effect, the camp superintendent was in charge of the camp, and the construction engineer of the construction.

The methods of construction and the arrangement of the duties and responsibilities are the result of almost two years of experience, in which many methods were tried and many changes effected before the organization was finally worked out on this system, which is proving very satisfactory.

There were as many negroes as whites, and, as may be noted from the plan of the camp, each race had its own sleeping quarters and separate tables in the dining room. Each had a barber; however, the negro barber worked in the laundry, while the white barber together with the camp porter constituted the field party for the engineer. The camp doctor, a life-term convict, took his turn at washing dishes and general camp work. In fact, every man was prescribed a full day's work and the camp maintenance was kept at a minimum. No



SKETCH OF CONVICT CAMP ARRANGEMENT

distinction was made between the blacks and whites on the job, and no trouble was experienced from a mixed camp.

All were dressed in ordinary work clothes, and some had a change of dress clothes which they wore on Sundays and occasions while off duty, which left nothing in evidence that would reveal it to be a prison camp. The morale of the camp was good, and the men were in good spirits, always looking forward to executive clemency in the way of a parole or pardon. All clothing, tobacco, medicine and other necessities were issued to the men from the commissary store. They were allowed all the tobacco they desired. The average cost of clothing and food per man per day was:

Cost of feeding one man per day	$0.40
Cost of clothing one man per day	0.08

None was allowed to leave camp when off duty except upon securing permission from the camp superintendent. They were allowed to go to town occasionally when they were off duty and could receive company at any time in camp. Some spent their spare time fishing and hunting; others had various hobbies which interested them. Many privileges were allowed them so long as they did not violate the camp rules. All were required to be in their tents at 8 p.m. for count and at 9 p.m. lights were out and all went to bed.

There were no guards at the camp, and no guns except a shot gun and rifle which the men were permitted to use for hunting. It was no difficult matter

for them to effect an escape if they so desired, yet few escapes were made during the two years this camp has been in existence. Men from thirty to fifty years of age proved best material for the camps. Those having a large part of their sentence served were good risks, and were usually careful to keep their prison records clean. Life-term convicts proved to be as dependable as any, and incidentally there were about thirty "lifers" out of the seventy-five at this camp.

At the start, these seventy-five men came on the job from all walks of life, practically inexperienced in the work they were to do. Soon an organization was effected, and after many changes these men were ably filling their places on the jackhammers, finishing concrete, blasting, running a grade, or driving a team. This was not accomplished without the usual amount of effort and the rectifying of various mistakes. Though sometimes discouraging, it after all was a pleasure to build a successful organization from such timber.

Much depended upon keeping the morale of the camp at its best and good spirits among the men on the job. They were always treated as if they were free men, each left to feel he was responsible for his part of the work. Each gang was contesting the other, working to a schedule laid out for the week or month. The drilling gang, closely crowded by the grading gangs, took every advantage to make progress. The culvert gang, sometimes ahead, and sometimes behind, were quick to complain if they were delayed for any cause.

A progress chart was placed on the wall at the office where all had access to it. This showed the total amount of work to be done by each gang, the amount completed to date, and a point was set that they should reach by the end of each month. Thus, each had a certain amount of work to accomplish each month to keep ahead and out of the way of the others and surprising results were obtained.

There was no punishment if a man failed to fill his part of the job, but he was immediately taken back to the penitentiary and replaced by another. Conditions were so much better at the camp that all were careful to avoid being taken back.

Results of Convict Labor—This camp was established in October, 1924. The last mile of this project, which at the start appeared almost an impossible undertaking with so small a gang and light equipment, will soon be completed. It has proved a success from an economical standpoint to the state highway department, and has opened a way for deserving men confined in the state penitentiary to do a constructive work and better fit themselves as citizens when their time expires.

The state highway commission, being assured of the success of this camp and satisfied with the results obtained, established their road camp No. 2, in the Kiamichi Mountains, in March, 1925, which is operating on the same system, and its success is being marked by the same progress as has been made elsewhere. The writer has spent two years as construction engineer in charge of Camp No. 1, and the past six months in charge of both camps, and feels qualified to advance these suggestions as an improvement over the present system in use:

Give the men a monthly allowance for clothing and tobacco and in addition $5 or $10 per month. Allow them their clothing and tobacco money each month to spend accordingly, and the balance to go into a reserve fund for them which they would receive when their time is finished. This would give them money to start out on when their time expires, and be an incentive for them to make good on the job. Allowing them to buy their own clothing and tobacco, from the commissary store, would eliminate any chance of their doing away with more than they needed, be less trouble to handle at the commissary, and would help to keep up a good spirit among the men.

Adopt some method whereby men with long prison sentences can by doing a certain amount of time on these jobs, maintaining good camp records, be assured of a parole or time-cut from their sentence.

It is next to impossible to handle this class of men

TYPICAL CONVICT CAMP BUILDINGS

and carry on a successful job unless a spirit of enthusiasm for the work, and good feeling among the men, can be maintained. They must have some objective ahead of them. It is not enough to assure them good food, a place to sleep, and the like, but they must be able to feel that they have a chance to better themselves, either by a shorter sentence, a parole, a pardon, or any way to gain their freedom.

The success of this job has been in part, at least, due to the one hope that if they made good they stood a better chance of gaining a pardon or parole than at the penitentiary. Some few have, however, well deserved, and many others are deserving and should be given, a chance to make of themselves good citizens.

These road camps are deserving of further consideration, for, with the penitentiaries already overflowing, here is an avenue where deserving men can do a constructive work, improve themselves, and finally work their way to their freedom and to good citizenship.

At the beginning of the construction above described, J. M. Page was state highway engineer. W. M. Trotter is division engineer, and A. O. Walker is construction engineer, for the state highway commission.

Holland Tunnel Ventilating Equipment

In an article on the ventilation of the Holland tunnels at New York which appeared in the issue of June 9, 1927, p. 934, it was stated that the fan motors were supplied by the General Electric Co. as part of its contract. This statement was made in error. The motors were included in the B. F. Sturtevant Co. contract for the fans. They are Westinghouse motors.

Wanaque Aqueduct and Watershed-Yield Controversy

Conflicting Views on Yield, Relative Advantages of Single Concrete Grade Aqueduct and Twin "Smooth-Bore" Steel Pipe, Value of *n* for Steel Pipe, and Compartive Costs, Including Engineering

DISTRIBUTION to the contracting municipalities of the engineering reports on the Wanaque aqueduct controversy, which were withheld from the municipalities and the public until the former made a united request for them, was made about June 10 or some seven weeks after the fourth of the series of reports. The main controversy is whether "smooth-bore" steel pipe, as recommended by Col. George A. Johnson in a report dated March 29, 1927, shall be substituted for the entire 21-mile length of the aqueduct in place of plain concrete on the gravity flow portions and either reinforced concrete or riveted steel on the pressure sections, as proposed by Arthur Pratt, chief engineer, and Morris S. Sherrerd, consulting engineer, and adopted by the commission in 1924. Related questions are allegations made in the Johnson report that steel is safer than concrete; that twin aqueducts will afford further safety; that the Pratt and Sherrerd figures both for the yield of the Wanaque watershed and the peak load on the aqueduct are excessive; that an aerator at the reservoir is unnecessary; and that the Pratt and Sherrerd cost estimates are far too low, thus making the Johnson substitute plan much less expensive than the Pratt and Sherrerd plan—but with a much smaller aqueduct capacity, although, Colonel Johnson claims, sufficient for all the water available.

Scope of Project—To facilitate understanding of the controversy, it may be said that the North Jersey District Water Supply Commission is under contract with eight municipalities, including Newark and Paterson, to build a storage reservoir on the Wanaque River of sufficient capacity to deliver an average of 100 m.g.d. to the contracting municipalities, the reservoir when full to be at an elevation of 300 ft. above sea level, and an aqueduct therefrom having a capacity of not less than 150 m.g.d. at its upper end and 97 m.g.d. for its lower stretch, which discharges into the Newark reservoir in the town of Belleville, near the northerly line of the city of Newark.

According to the 1924-25 report of the commission, the total length of the aqueduct as planned at that time was 109,070 ft., or 20.66 miles. From the dam to a point in Little Falls, a distance of 68,480 ft., or 12.97 miles, the aqueduct would have a capacity of 150 m.g.d. and a cross-section equivalent to a 9½-ft. circular conduit, and would consist of grade aqueduct, grade tunnel, and pressure aqueduct. From Little Falls to Grove St., Montclair, a distance of 15,850 ft., or 3.01 miles, the aqueduct would have a capacity of 105 m.g.d. and cross-sectional areas equivalent to a circle 7 ft. 7 in. and in other places 7 ft. 2 in. diameter, this portion also including grade and pressure aqueduct and grade tunnel. The third section of the aqueduct, from Montclair to Broad St., Bloomfield, a distance of 4,240 ft., or 0.8 mile, would also have a capacity of 105 m.g.d. and a cross-sectional area about as in the No. 3 section and would be in part gravity aqueduct and part pressure aqueduct. For the remaining distance, 20,500 ft., or 3.88 miles, the capacity would be 97 m.g.d., size and material not then determined, but all pressure aqueduct [since planned by Pratt and Sherrerd as 90-in. riveted steel pipe].

Summarized otherwise, there would be 37,010 ft. or 7.01 miles of grade aqueduct (all plain concrete), comprising 34 per cent of the total; 61,830 ft., or 11.71 miles, of pressure aqueduct, being 57 per cent of the total, and 10,230 ft., or 1.94 miles, of tunnel, comprising 9 per cent of the total. Of the tunnel, 860 ft. at the Wanaque dam and the balance lying in Little Falls and Montclair are already completed, the longer tunnel having been practically finished early in July, 1926.

Construction was begun Oct. 31, 1918, under a contract with Newark only for a capacity of 50 m.g.d. To provide for the needs of the other communities, the average daily capacity was increased to 100 m.g.d. The engineers for the commission (Messrs. Pratt and Sherrerd) after the 100-m.g.d. capacity was agreed on as average delivery for the entire year, proposed to make the aqueduct large enough in its various parts to carry a peak load of 140 per cent. At the instance of Newark and Bayonne (the latter then proposing to come into the district), the peak load was raised to 150 per cent because of the lack of local storage in several of the contracting municipalities—all of which agreed to the increase in peak load.

The commission serves merely as an agent for the eight municipalities who pay for the construction cost pro rata according to their respective allocations of water. Section 13 of the final and governing contract provides that nothing in the contract "shall be construed to permit the commission to expend any amount in excess" of $20,350,000, except on consent of the contracting municipalities and that none of the latter shall be obligated "to pay any sum for the construction of said work in excess of the sums respectively set after their names."

Developments—Up to the date of the second annual report of the commission, June 30, 1926, the Great Notch tunnel, which had been put under construction before the rest of the aqueduct because of the longer time required for the work, was practically completed and, the report stated, "plans and specifications are in preparation for several sections of aqueduct."

On Sept. 23, 1926, the commission adopted a resolution authorizing Col. George A. Johnson, consulting engineer, New York City, to make an investigation and report. "This study," says Colonel Johnson in his report of March 29, 1927, "was ordered by the North Jersey District Water Supply Commission that full information might be made available respecting the type of water transportation lines between Wanaque dam and Belleville reservoir which would fulfill the requirements most promptly, adequately and economically." Colonel Johnson's report was followed by an "Analysis" by Messrs. Pratt and Sherrerd, dated April 7, a "Reply" thereto by Colonel Johnson dated April 13, and a "Memorandum on Reply" by Messrs. Pratt and Sherrerd dated April 21.

Colonel Johnson recommended the substitution of twin "smooth-bore" steel pipe lines for the major portion of the aqueduct and the same material in a single line for the remainder.

For ease of comparison, the four engineering reports will be reviewed under the main subjects of contention, noting first that Colonel Johnson states that most of the time between Sept. 23, 1926, the date of his authorization to make the investigation, and Nov. 1 was taken up with conferences with the engineering staff of the commission, checking over reports, etc., but that beginning Nov. 1, 1926, he had at work on this investigation a staff of 15 engineers, including a chief engineer, an assistant and a principal assistant engineer, and a designing engineer.

Yield of Watershed—The Pratt and Sherrerd estimate of yield of the Wanaque watershed, says Colonel Johnson, was based on studies of the yield of the (nearby) Pequannock drainage area, available for over 30 years, which placed the safe yield at slightly over 1 m.g.d. [These studies were made before the Wanaque runoff noted below, had been recorded.] This figure, Colonel Johnson accepts. Turning to the Wanaque, Colonel Johnson states, in substance, that mass-curve studies for the yield from a drainage area of 94.4 sq.mi. with available storage capacity of 26,000 m.g., a daily draft of 100 m.g.d., indicates that, using the Wanaque runoff for 1920 to 1926, the mean daily yield of the watershed would be 116 m.g., or 1.234 per sq.mi. gross. Deducting evaporation (using FitzGerald's "evaporation constant of 43.63 in. per year") from the reservoir would give a mean daily flow of 108.7 m.g., or 1.15 m.g. per sq.mi. Applying the probability methods of Allen Hazen as set forth by him in *Trans.* Am. Soc. C.E., 1904, and Charles E. Sudler in *Trans.* Am. Soc. C. E., December, 1926, p. 1917, Colonel Johnson finds a daily possible discharge from the reservoir of 92 m.g.d. for 99 per cent of the time and 98 m.g.d. for 85 per cent of the time. He adopts the latter figure "as the entirely safe yield of the stream." From this he then deducts 10 m.g.d. for required waste into the stream below the dam, leaving 82 m.g.d. as the "safe dependable yield of Wanaque reservoir," but he places the indicated potential net yield between an assured maximum of 88 m.g.d. and a minimum of 82 m.g.d. By making available 10 ft. of storage in Greenwood Lake, some 3 to 4 m.g.d. might be added to these figures, but, Colonel Johnson states, "no definite assurance can be had of the availability of Greenwood Lake in this manner in time of need."

On this analysis of the Wanaque safe yield, Messrs. Pratt and Sherrerd comment at some length in their "Reply." Referring to probability methods, they state: "While such studies are interesting and undoubtedly have a value under certain conditions" [we have] always been of the opinion "that the 35-year record of rainfall and runoff on the Pequannock watershed at hand" affords the "most reasonable, sound and practical data to use for estimating the Wanaque yield." They cite a report made in 1918 to the city of Newark by John R. Freeman, in which the latter, using the Pequannock records, stated that the "Wanaque was good for an average of 1.1 m.g.d. per sq.mi., or 104 m.g.d." Messrs. Pratt and Sherrerd add: "Since then gagings have shown that the Wanaque and Pequannock watersheds are very similar so that it is entirely reasonable to assume that the Wanaque will yield as much as the Pequannock. Using Mr. Freeman's Pequannock estimates for the Wanaque, we get a yield of 111 m.g.d. for the Wanaque watershed."

As to Colonel Johnson's use of probability methods, Messrs. Pratt and Sherrerd state that the proper application of this law requires that "a number of observations be available within both the zones of maxima and minima, as well as the average," whereas the figures used by Colonel Johnson "cover only six years' runoff of the Wanaque shed, and were in the minima range, so that the effect of using the probability curves for the lower range only and plotting as though they were averages is to indicate the probability of much lower averages to come when there is reason to believe that the runoff of 1920 to 1925 is already at the bottom of the curve."

Messrs. Pratt and Sherrerd add that when they knew that the Wanaque was estimated at 100 m.g.d., runoff figures for that drainage area were not available. They state that arithmetical calculations, using 2-ft. flashboards on the Wanaque dam as planned, give 103 m.g.d. gross; or deducting 7 m.g.d. "to be let downstream" [not the 10 m.g.d. used by Colonel Johnson] 96 m.g.d. net. They then state that in order that the commission "may have a correct figure by the Hazen-Sudler method, we have had the Wanaque yield figured out on the basis of the Pequannock long-time records, which include, of course, both maxima and minima . . . we find the gross yield without flashboards to be 107.5 m.g.d., equal to 100 m.g.d. net" [their assumed yield for the Wanaque].

Colonel Johnson, in his rejoinder, adheres to his former figures on the Wanaque watershed yield and gives figures from which he concludes that on the basis of the Wanaque runoff records for 1925-26, "had the reservoir been in service in 1924, and a draft of 100 m.g.d. been imposed upon it, it would have been emptied in the fall of 1926." These figures are based on arithmetical and not probability calculations.

In their final rejoinder, Messrs. Pratt and Sherrerd give the yearly runoff per square mile for the Pequannock and Wanaque watersheds for the years 1913 and 1914 and the six years 1920-26. The average is 435 m.g.d. per sq.mi. for the Pequannock and 454 for the Wanaque, but the latter would have been reduced by about 3 per cent evaporation had the Wanaque reservoir been completed. From this they again deduce a safe yield of 100 m.g.d. from the Wanaque.

Peak Load—Messrs. Pratt and Sherrerd point out, as has already been stated, that the contract with the municipalities calls for a peak load of 150 m.g.d. To this, Colonel Johnson replies that he considers 135 per cent safe.

Concrete versus "Smooth-Bore" Steel—Advantages claimed by Colonel Johnson for steel over concrete are that the steel lines could be built within 16 months, whereas the concrete would take considerably longer; that the concrete aqueduct being larger and protruding above the surface would lead to opposition from property owners, possible suits, etc., that might delay the work and increase land damages; that the greater flexibility of the steel as to location makes possible a saving in length; that there would be two periods of winter weather for the construction of concrete as against one for steel, leading to increased cost; that concrete is much more reliable than steel as to material

and workmanship, and that with twin steel lines, if one should fail, "the other will maintain a diminished but uninterrupted service." As to the relative life of concrete and steel conduits, Colonel Johnson says: "The evidence gives steel a life of 100 years," cites examples of its having been in use for a number of decades and opinions ranging as high as "100 years, or more." Taking up concrete grade aqueducts, Colonel Johnson says "There is a vast amount of evidence showing their substantial permanency," but then cites, in support his own argument for steel, the recent paper by Prof. George F. Swain, "Steel for Strength and Security." Both sides go into detail as to relative merits of steel and concrete. Messrs. Pratt and Sherrerd refer to Godfrey's "Engineering Failures" for evidence that steel as well as concrete structures must be well designed and built.

As to relying upon a single conduit for a part of his proposed steel lines, Colonel Johnson states that in the lower part of the aqueduct proximity to three other main water-supply lines, from two different sources, makes interconnection with them at close intervals easy in case of a break in the Wanaqua single line. Messrs. Pratt and Sherrerd say that there are also facilities for interconnection in case of a break in their proposed concrete grade flow line, but Colonel Johnson replies to this that it could not be done nearly so easily, owing to greater distances.

In his first report, Colonel Johnson rules out reinforced concrete from consideration. He claims that "smooth-bore" (lock-bar) steel conduits are stronger than steel and have greater carrying capacity. In one of his later reports he lists electric and hammer weld with lock-bar as "smooth-bore" pipe and cites examples of electric welded conduits.

Messrs. Pratt and Sherrerd urge that rather than provide twin conduits, strength be added to a single conduit or that a second conduit be built to an independent source.

Relative Carrying Capacities—Colonel Johnson accepts the Pratt and Sherrerd allowance of 150 m.g.d. for the concrete portion of their proposed aqueduct line and lesser quantities with the succeeding take-offs, but urges that there is no need for capacity above some 120 m.g.d., since his computations make the safe yield but 85 m.g.d., which at 135 per cent peak load required calls for less than 115 m.g.d. flow capacity.

For "smooth-bore" pipe he uses $C = 124$ as the coefficient of discharge in the Chezy formula, equivalent to $n = 0.013$ in the Kutter formula. Among other authorities for this assumption, he refers to an article by R. E. Horton in *Engineering News*, Feb. 24, 1916, described by Colonel Johnson as "an extensive tabulation of the values of n in Kutter's formula (see also Merriman's "Hydraulics," tenth ed., p. 289)." After summarizing Mr. Horton's data, Colonel Johnson states: "The above figures indicate an opinion or collection of opinions; nevertheless the conclusion seems proper that smooth-bore pipe (designated by Mr. Horton as 'lock-bar') is generally conceded to have a greater discharge capacity than riveted steel pipe by something like 25 per cent."

Colonel Johnson also states that friction losses in his proposed steel conduits can be kept down by brushing, throwing one of the twin lines out of use for that purpose. In one of his later reports he states that, for 72-in. riveted steel pipe in the lower stretch of his project, in his computations he has used $n = 0.017$.

Messrs. Pratt and Sherrerd object to the Horton data as "a mere tabular expression of Mr. Horton's opinion." They also state: "Mr. Johnson's argument in favor of 'lock-bar' steel pipe manufactured by the East Jersey Pipe Co., associated with T. A. Gillespie Co., contractors, is not refuted. This pipe is well thought of by the engineering profession and your engineering department would wholeheartedly recommend it so far as its strength is concerned and would write specifications so that it could be put into competition with riveted pipe, but we cannot accept Mr. Johnson's assumption as to the quantity which would flow through a 72-in. pipe of this manufacture after it had been in service." They add: "The company itself [named above], in its 'Handbook of Pipe,' recommends a coefficient of 0.015 for 'clean steel riveted pipe' (p. 125) and claims that riveted steel pipe carries 10 to 15 per cent less water than lock-bar" (p. 73). Messrs. Pratt and Sherrerd also cite a report of measurements on the Jersey City pipe line made by the National Board of Fire Underwriters as indicating coefficients of about 0.015 for the new pipe (lock-bar) and over 0.018 for the old. If what Messrs. Pratt and Sherrerd consider to be a proper value for n (0.018) be used, they state, then "the Johnson twin 72-in. lines" would deliver only 77 m.g.d., which is below the Johnson estimate for the Wanaque yield.

Messrs. Pratt and Sherrerd also state that they have never heard of keeping "pipe smooth by closing off one line at a time and brushing it." They believe that "when the draft on the pipe line begins to reach its maximum, it becomes impracticable to shut off one line for a sufficient length of time to clean it up," and cite Newark experience to that effect. They state that tubercles could not be removed by brushing and express a belief, supported by a citation, that when tuberculation is taken into account there is relatively little difference in the discharge capacity of riveted steel and lock-bar pipe.

Aerator—To utilize the head afforded by the different reservoir stages, Colonel Johnson proposes to omit the aerator just below the Wanaque reservoir, called for by the Pratt-Sherrerd plans, and feasible under them because their grade aqueduct starts at substantially the reservoir bottom. He claims that copper sulphate may be used if tastes and odors give trouble and that for landscape effect the water that must be wasted downstream may be used. Messrs. Pratt and Sherrerd persist in their recommendation for aeration, and make citations from published writings of Colonel Johnson and others in favor of aeration.

Relative Costs—The Pratt and Sherrerd estimates for their proposed single conduit (partly concrete, gravity flow) from the Wanaque to the Belleville reservoir (20.66 miles), with capacities diminishing progressively from 150 m.g.d. to 105 and 97 m.g.d., totaled $6,343,000 (with no allowance for engineering and administration). Colonel Johnson re-estimated the Pratt and Sherrerd project as $8,860,127 and put the cost of his own all-steel project at $7,911,930, or $948,197 less. Then by substituting 72-in. "smooth-bore" pipe for the Pratt and Sherrerd 90-in. riveted steel in the lower portion of the aqueduct he figured an additional saving of $397,182, which on being credited to the Pratt and Sherrerd project, as amended by Johnson, makes the comparative costs $8,462,945 and $7,911,930, a net sav-

ing by the Johnson plan claimed as $557,015—but for an aqueduct carrying much less water than the one proposed by Pratt and Sherrerd.

In their review of the Johnson report, Pratt and Sherrerd point out an omission of $143,000 for land in the lower reach of the aqueduct, which Colonel Johnson admits. This item, added to Colonel Johnson's previous comparative figures for the two schemes, brings his comparative costs up to $8,054,930 and $9,003,127, or a saving of $948,197 for the all-steel smooth-bore line (p. 11 of Colonel Johnson's "Reply"). Later in this document (pp. 28 and 29) Colonel Johnson accepts a further correction by Pratt and Sherrerd, this time an error in reducing to 72 in. the size of their 90-in. riveted steel pipe on the lower end of the line (which error Colonel Johnson attributes to misinformation supplied him as to the elevation of the Belleville or terminal reservoir). On adding $200,000 for enlarging this stretch of pipe (actual enlargement not stated, but $397,182 given above was the saving claimed by reducing the diameter from 90 to 72 in.), the Johnson re-estimate for the Pratt and Sherrerd project is decreased to $8,803,127 and the difference between the Johnson re-estimate for the two projects becomes $748,197 in favor of all-steel conduit project.

In their "Analysis" of the first Johnson report, Messrs. Pratt and Sherrerd state that the difference between their estimate and the Johnson re-estimate of the cost of the Pratt and Sherrerd project is due largely to the higher unit costs assumed by Colonel Johnson, which, they figure, amount to $906,114. The comparative unit prices, giving Pratt and Sherrerd figures first, are: top soil, $1 and $1.50; rock excavation, $5 and $6; refill and embankment, $1 and $2; concrete, $15 and $20; reinforced concrete, $20 and $25; steel, 6 and 7c. Both agree on earth excavation at $1.50; surface dressing, $1; cement, $3; steel pipe, $1.50. Pratt and Sherrerd state that their "unit prices are based on actual contractors' bids" on work for the water commission and "similar work" elsewhere. They point out that Colonel Johnson included 15 per cent engineering and administration on their scheme and only 10 per cent on his own [the Johnson claim in justification being shorter time of execution of an all-steel than a part-concrete line]. They urge that to make their all-steel estimate of $6,343,000 comparable with the Johnson re-estimate of $7,911,930, there should be subtracted $686,428 for engineering, and that $143,000 should be added for land (as explained above) giving a corrected Johnson re-estimate of $7,368,502, compared with their original $6,343,000. "So that Mr. Johnson's project," they say, instead of saving the commission $551,000, as claimed by him on p. 14 of his report, "will cost $1,000,000 more and besides that will have only two-thirds the capacity."

In his "Reply," Colonel Johnson makes the allowances already noted, but insists that his unit prices are "prevailing prices." He also urges that the original Pratt-Sherrerd estimate of $6,343,000 should be increased by an allowance for "engineering, administration and police" of 15 per cent on the grade (concrete) aqueduct and 10 per cent on the 90-in. steel section, or $856,750, thus bringing the total to $7,199,750.

In the Pratt-Sherrerd "Memorandum" on the Johnson "Reply," it is urged that "Mr. Johnson's estimates of construction costs are practically identical for the two projects—even admitting, for the moment, Mr. Johnson's unit cost assumptions" for the original Pratt-Sherrerd line. They urge that the Johnson "item for administration and engineering is at the rate of $63,000 per mile for the K3 [original Pratt-Sherrerd project] and $41,000 for the M3 [all-steel] line." They add: "Either charge is unreasonable and the difference in favor of his own line of $22,000 is more than the actual cost of field supervision on Contract 3" ($20,000 per mile) which "included two miles of tunnel—the most expensive type of aqueduct to build and supervise and which took nearly four years to build." They also say that Colonel Johnson's total of $1,019,294 for administration and engineering on their project is unreasonable for any aqueduct from the Wanaque reservoir, and that it is three times the entire charge for similar expenses last year on the entire Wanaque project, including reservoir construction and studies for the aqueduct; also that a small addition to the personnel will be adequate for the administration of the aqueduct construction.

In their final report, Messrs. Pratt and Sherrerd then present their original estimate of the cost of building the upper or grade-line concrete (with pressure siphons) stretch of their recommended project, with the addition of "a liberal estimate for administration and engineering." These figures are: Construction cost, $4,549,000; land, $439,000; administration, engineering and legal, $600,000; total, $5,588,000, "which is $1,184,000 less than Mr. Johnson's own estimate for [this part of] the M3 [twin-steel] line," with a capacity range (according to pressure) set by Colonel Johnson at 110 to 180 m.g.d., for the 72-in. twin "smooth bore" conduits, 68 to 112 for the twin 60-in., and 68 to 90 m.g.d., for the single 72-in. "smooth-bore" conduit. These capacities, Messrs. Pratt and Sherrerd claim, are too high and would be much less on substituting $n = 0.018$ for Colonel Johnson's $n = 0.013$, and the reduced figures, they state, should be compared with 150 m.g.d. for the Pratt-Sherrerd gravity-flow line.

Final Cost of Entire Wanaque Project—Colonel Johnson concludes, after reviewing all the construction costs data, and taking into account his estimate for the "smooth-bore" steel conduits, that the entire cost of the Wanaque reservoir, aqueduct and accessories will be at least $23,878,860 or $3,528,862 above the estimate of $20,350,000 which is the limit set in the contract with the municipalities above which the commission cannot go without their consent.

Winter Setting Temperature of Concrete

Outdoor tests, determining the temperatures generated in concrete by three kinds of cement—standard, portland, alumina and high early strength portland—when permitted to set under identical conditions in freezing weather, are described in detail in Bulletin 8 of the Michigan Engineering Experiment Station. The tests showed that concrete made with standard portland cement reached freezing point 130 hr. after mixing, while the others required 140 and 144 hr. The bulletin also concludes that portland cement concrete can set sufficiently to be past danger due to freezing, without the application of heat to the concrete during setting, by use of heavy forms, properly covering the exposed surfaces and maintaining a mixing temperature of not less than 80 deg. F.

Building a 16-Mile Levee on the Colorado Delta

Under Spur of Flood Menace, with Equipment Working Three Shifts Daily, 1,000,000 Cu.Yd. Were Placed in Levee in 40 Days

DOWN on the Colorado River delta, on the Mexican side of the line, 500 men and 1,200 head of mules worked and sweated in the spring heat and dust of the desert, rushing to completion a barrier, 16½ miles long, against expected floods on the Colorado River. It was a race against time, with the odds somewhat against the builders. On May 14 the actual placing of the earth yardage was completed and attention was centered on protection and strengthening in preparation for the battle to maintain the levee when the flood waters stand against it. Meantime, as though the river

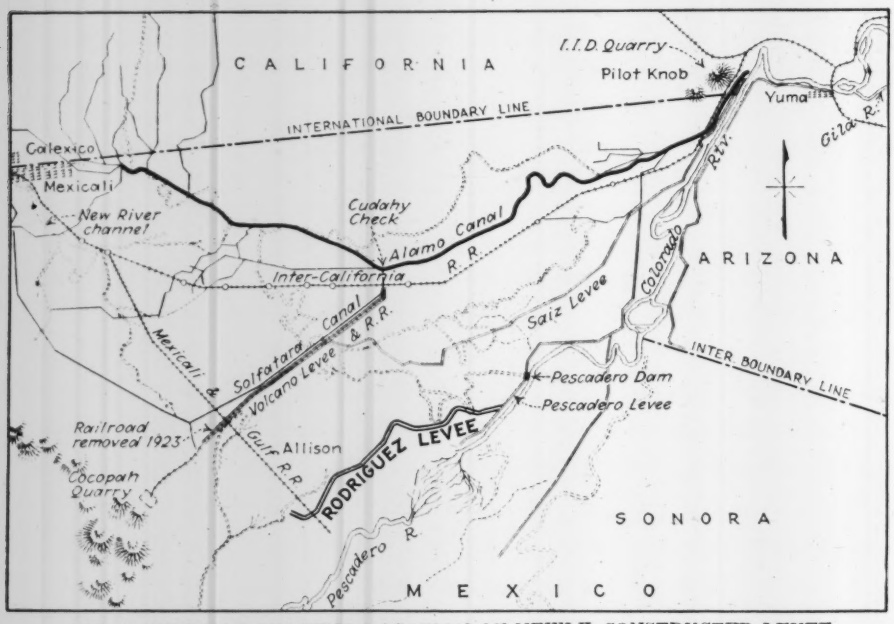


FIG. 1—KEY MAP SHOWING LOCATION OF NEWLY CONSTRUCTED LEVEE
(For additional maps see *Engineering News-Record*, March 17, 1927, pp. 439 and 441.)

were throwing out skirmish lines to try the strength of the new breastwork, two flash floods rose up against the levee as it was being built, one along a 6-mile front and the other against 12 miles of the unfinished earth embankment. Due to the men and equipment already on the battle line the levee was held in both cases.

This new levee is known as the Rodriguez levee. Starting at a point on the Pescadero levee between mile posts 28 and 29 and extending to the southwest 16½ miles, it follows approximately the overflow line of the flash flood of February, 1927, which showed a discharge at Yuma of about 100,000 sec.-ft. The location crosses the tracks of the Mexicali & Gulf Ry. near the present rail head and terminates a short distance beyond.

Construction of this levee was financed jointly by the Colorado River Land Co. and the government of Baja California. Its primary function is to protect from floods the cultivated lands in Mexico to the north and northwest which lie at a lower level. However, the builders point out that the first few miles of this levee really protect channels through which flood waters have

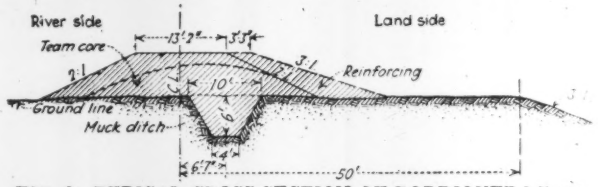


FIG. 2—TYPICAL CROSS-SECTION OF RODRIQUEZ LEVEE

previously flowed into Salton Sea and that if flood waters should break through there with any force, the old channels would be reopened and the flow would find its way into Salton Sea as it did in 1906-07.

The safety of the lands protected by delta levees, in the opinion of the Rodriguez levee builders, depends upon whether the runoff this year is concentrated or is distributed over a fairly long period. Snow runoff from the watershed might easily cause a 200,000 sec.-ft. flood, and, although the Rodriguez levee is constructed with a freeboard of about 4 ft. above the water level that is taken to represent a 200,000 sec.-ft. flood, it is not believed that a levee without rock facing, and a new and unconsolidated levee, could long hold back such a flood. When water stands against a levee composed wholly of alluvial silt it is only a short time before there is complete saturation and collapse.

The method of constructing the Rodriguez levee was first to clear the location of trees and brush and then to excavate with a dragline on the land side of the center line a muck ditch, 6 ft. deep, as shown in Fig. 2. Material with which to fill the muck ditch and to build up the levee was taken from borrow pits on the land side of the levee by fresno scrapers and dragline excavators. The edge of this borrow pit was kept 50 ft. from the center line of the levee, thus leaving a berm 28 ft. wide on which the dragline excavators, mounted on crawlers, could move along.

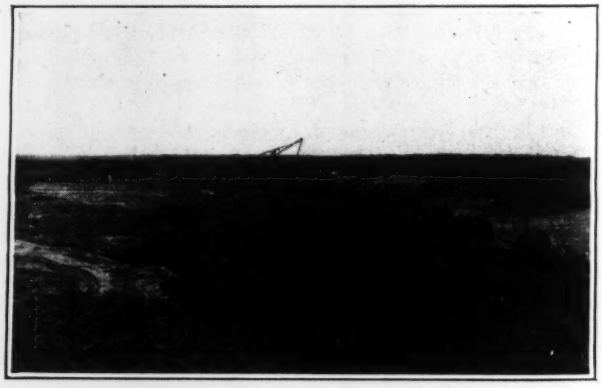


FIG. 3—FILLING THE MUCK DITCH WITH THE DRAGLINE

In explanation of the muck ditch, into which is put back the same quality of material as that excavated, it should be said that this is a safeguard against seepage through the levee in time of flood. Sedimentary deposits built up on the delta in consecutive layers often contain driftwood and sometimes the layers themselves, when dried, crack and open up passageways that would be most serious in times when flood waters stand against levees consisting of only this fine silt. Hence the muck

FIG. 4—BUILDING UP LEVEE WITH FRESNO SCRAPERS

FIG. 5—TYPICAL DRAGLINE OPERATION

ditch is standard practice and is regarded as particularly important when no rock facing is used.

The sequence of operations in the levee construction was as follows: The muck ditch was dug with a dragline and the excavated material placed on the water side of the center line. A second dragline, moving along behind, filled the muck ditch, taking material from a borrow pit on the inner or land side of the levee. The muck ditch was over-filled by heaping material above ground level, forming a sub-levee where a fight could be made against a flash flood. Then, following the dragline work, the fill was raised by teams and fresnos, the compacting effect of these operations solidifying the core. Draglines completed the levee and brought it to final grade.

The average height of the levee is 7 ft. above the natural surface of the ground, the top width about 13 ft., and the side slopes 2 to 1. As soon as each division of the work was completed to these dimensions and provided there was no emergency demand elsewhere, the men and equipment began to reinforce the section by adding more material on the land side. This reinforcement increased the top width about 3 ft. and made the base 9 ft. wider, extending the land side slope to 3 to 1.

Eight dragline excavating machines were distributed along the 16-mile levee and each of them worked three 8-hr. shifts daily. Six mule camps were located along the levee where water could be obtained for the stock. The average of these camps was 200 mules or 50 scraper teams. Five tractors were employed on the work, usually on a daily shift of 12 hours, and were engaged for the most part in plowing for the teams. Each tractor released from five to eight 4-mule plow teams which were put on scrapers and consequently increased the yardage per day. At the peak of the construction period the daily yardage handled by all means was about 31,000 cu.yd. A total of about 1,000,000 cu. yd. was moved in the 40-day construction period.

The engineers who built this levee have before them the problem of maintaining it through the summer flood season and hence the work was by no means finished when, on May 14, the last of the yardage was placed in the structure as originally designed. Work was then begun immediately on the reinforcing already mentioned and the placing of brush held down by earth-filled sacks on the river side of the levee. This brush facing was put on in lieu of the rock revetment that was not possible within the limitations of time and cost. There is no rock available within many miles of this work. Brush wing dams or retards are also being built, set at an angle of about 30 deg. with the center line of the levee and extending out 30 to 500 ft. from the toe of the levee, as a protection from current erosion. Neither time nor funds were available for building a railroad on the levee, and hence all maintenance and the transportation of men and material will have to be done in time of flood by means of trucks running along the top.

The labor used in the construction of this levee was

FIG. 6—SAND-BAG DEFENSE WHEN LEVEE IS ATTACKED
This was a case of collapse due to saturation. Dark color indicates saturated materials near water's edge.

for the most part Mexican, with a sprinkling of Hindoos and Chinese. The heat was such that it was almost impossible to hold labor for any length of time, and the turnover amount to about 50 per cent per month.

The construction and maintenance of this levee are under the general direction of W. I. Bassett, chief engineer and general manager of the Mexicali & Gulf Ry., to whom *Engineering News-Record* is indebted for information in this article. James W. Stone is assistant engineer in charge of all field operations. O. V. Humason and J. E. Little directed the team and dragline work.

American Society for Testing Materials in Middle West

Society Celebrates Quarter Centenary—Proceedings Include X-Rays in Industry, Endurance Researches, Practical Magnetic Testing of Steel, and Concrete Quality—Standardization Unusually Active

GOING west of the Alleghenies for the first time in its history, the American Society for Testing Materials last week showed by the character of its meeting at French Lick Springs, Ind., that it is not dependent on the attractions of Atlantic City or Asbury Park, where it has gone uninterruptedly for more than twenty years. The meeting was quite as active and efficient as any prior one, and while the total registration of members was smaller—637 against about 900 last year—the working attendance and the average participation in the sessions was fully up to standard. Because of the success of the experiment, it is almost certain that other Mid-West meetings will be held at intervals of a few years, in recognition of the importance of the great industrial regions of the Central States.

As always, the society made its meeting a busy week of work, with 13 sessions and in addition a large number of meetings of its own committees and those of numerous other organizations. The proceedings showed steady extension of the field covered; reduction of activity in the older subjects was more than balanced by increase in the newer ones. Standardization or specification work probably exceeded that dealt with at any prior meeting, the standing committees having been very active during the year. Revision of specifications to eliminate weaknesses and disputed features was no doubt hastened by the approaching publication of the society's triennial book of standards, but there is evidence that progress in the technology of industries also exerted pressure on the committees.

Though the list of technical papers was rather small, it included elements of distinct brilliancy. A group of four papers reported new endurance results, and another group the use of magnetic testing as a practical check on steel quality. The results of the second part of the investigation of sulphur in steel were reported. A symposium on field control of concrete quality drew large attendance.

The society having been incorporated in 1902, a dinner was held to mark the 25th anniversary of the event. On this occasion the beginning and growth of the organization were reviewed in happy terms by the retiring president, James H. Gibboney, and by a number of the twenty-five-year members. Honorary membership was conferred on William R. Webster, first chairman of the steel committee; Robert W. Lesley, the well-known cement pioneer; and A. A. Stevenson, long a leader in the councils of the society and one of the strongest factors in shaping its career. The first award of the Dudley Metal was made at the dinner to Dr. D. J. McAdam, Jr., metallurgist at the Naval Engineering Experiment Station, Annapolis, for his paper, "Stress-Strain-Cycle Relationship and Corrosion-Fatigue of Metals," presented last year (*Engineering News-Record*, July 1, 1926, p. 20).

Marburg Lecture—At another special session the second Edgar Marburg Lecture was delivered, on invitation of the society, by Prof. George L. Clark, of Massachusetts Institute of Technology. Taking as his subject "X-Rays in Industry," he outlined the generation and the methods of use of X-rays, and related how the correspondence of their wave-length with the spacing of the structural elements of unit particles of matter lead to the diffraction of monochromatic X-rays by crystals, whether single or aggregated, to form light-patterns characteristic of the material and its physical state, including presence of internal strain or fibrous structure. Almost every field of material has given opportunity for useful application of the analysis which these patterns make possible, and the speaker illustrated these by a large number of photographic slides from actual practice, covering service extending from detection of strain in steel to differentiation of rayon and determination of the constitution of rubber.

Specification Committees

Specification committee work, the essential objective of the society, was probably more active this year than ever before. A very large number of new specifications and methods of test or analysis was reported, and many more were revised; of the revisions, some were advanced to standard at once, so as to have a place in the book of standards which the society will publish this fall. The work appeared to have been done carefully and with thorough discussion in committee of divergences between producers and consumers; almost no points of dispute were carried before the society. A threatened break over the prohibition of converter steel in high-temperature castings was avoided by a last-minute decision of the disputants to hold the matter in committee until next year.

Much work was done by the committees in drafting and perfecting definitions of terms specific to their subjects, a process which is evidently tending toward clarifying many difficulties in purchase and use of materials. Some differences of view were compromised in the adopted definitions, as in that for brick, framed after some years' discussion:

Brick—A structural unit formed while plastic into a rectangular prism, usually solid and 8 x 3¾ x 2¼ in. in size followed by a footnote explaining that as usually applied it means a clay product.

Investigational work also is of rapidly increasing importance. Nearly every specification committee has various investigations under way, either to check the value of a test method or to fix on the merits of materials or methods of treatment. Only a few items of such work reached the point of reporting results this year.

Growth of the scope of committee work was shown by a report from a new committee, on building stones. This committee plans to study all phases of stone service and use, from weathering resistance to mortars and stone-setting. Two new subjects are under discussion for possible committee work: heat-transmission testing of building insulation, and sampling of streams for test of water quality.

Co-operative work with other organizations, technical and industrial, is an important part of the committee work. Joint committees are dealing with concrete cul-

vert pipe, sulphur and phosphorus in steel, yield-point testing, heat treatment terms, and properties of metals at high temperatures. Other intersociety co-operation is going on in steel castings and forgings, rails, copper wire, bearing metals, petroleum products and other items.

Specification work was reported on wrought iron and steel products, malleable castings, cast iron, tests for magnetic properties, rubber products, textiles and tests for textiles, timber, ferro-alloys, test methods for petroleum products, for electrical insulation and for slate, thermometers, paint and lacquer materials, rosin, wire cloth, zinc coatings, copper wire, non-ferrous metal products, resistance wire, metallographic testing, building and paving brick, concrete culvert pipe, hollow tile, lime, gypsum, waterproofing and roofing, road tar and aggregates, and tests for concrete aggregates.

Some Specification Work—A few special points of the specification work invite attention.

In cast iron, a new bend-test bar was tentatively adopted (1.15 to 1.20 in. diameter by 18 in. long between supports). Steel rail specifications were made identical with those of the A.R.E.A. and the A.E.R.E.A., and in this form were advanced to standard. A joint structural steel specification for locomotives and cars was adopted as tentative, while that for structural silicon steel was advanced to standard. In non-ferrous insect screen cloth, a 22-mesh heavy-wire size was added to the previous (14 to 18 mesh) list, for the tropics, where the insects appear to be unusually small. The specifications for copper trolley wire, developed jointly with the A.R.E.A., are now identical for the two organizations, and the same result may soon be secured for bronze trolley wire, giving a national standard for both kinds. Railroad journal bearing specifications were substantially harmonized with those of the A.R.E.A. New specifications for building brick and paving brick were adopted, the former fixing three grades classified by crushing and bending strength flatwise, and the latter specifying only a rattler test (with loss limit to be fixed by the contract). The concrete culvert pipe specification being worked out by a joint committee of seven organizations is complete except for fixing absorption.

The society's revised portland cement specification (strength requirements increased) of last year has recently been adopted by the Federal Specifications Board, and is also being presented to the American Engineering Standards Committee for adoption as an American standard. The natural cement specification is being revised and divided into two. Fluid cement-water-mixture tests of portland cement have been carried out, to develop a better test than present ones.

In the field of concrete, new methods of test for voids, surface moisture and apparent specific gravity of sand were adopted. A revision of Chapter V of the Joint Committee report was recommended, providing for proportioning either by maximum water content or by specific amounts of the aggregates, the other factor being in each case determined by the slump specified. Subcommittee reports gave useful reviews of practice in designing mixtures, and knowledge of durability as affected by aggregates.

New specifications for structural timbers (joists, planks, beams, stringers and posts) were adopted, and the older ones canceled. The new form, presented as tentative last year, is identical with that adopted recently by the A.R.E.A., and represents an application of the American Lumber Standards. It is quite unlike ordinary specifications, being composed of (1) a general discussion of defects, (2) a list of grades, uses and sizes of timbers, (3) a grouped set of specification clauses, incorporating extensive tables of the sizes of different defects allowed in different-sized timbers of different grades, (4) a large number of coded specifications (e.g. for "Beams and stringers, select, 85 per cent heartwood, square edges") which list by number the applicable clauses of the previous grouping, and (5) a chapter on working stresses, written in specification form but declared to be for information only.

Corrosion Tests—Ten-year corrosion results on exposed plain iron and steel sheets were reported, confirming shorter-period results as to the advantage of copper-bearing metal in atmospheric exposure. In the total-immersion tests, which are nearing completion, copper-bearing metal shows no advantage. Seawater tests are in progress. Galvanized-sheet atmospheric tests have been exposed now for a year, so far with no failures. A subcommittee on metal culvert corrosion tests has been organized, which as a first step will assemble the results of prior studies of corrugated sheet culverts.

Non-ferrous corrosion tests in various solutions have not shown satisfactory agreement between different laboratories, and a modified procedure will next be tried. Accelerated electrolytic tests have been completed, but the applicability of the results to saline corrosion rates is doubted. Atmospheric corrosion tests of a large number of non-ferrous sheet metals are soon to be started, in six locations; tension specimens will be included, for periodic measurement of loss in strength and ductility.

On the related subject of protecting ships' bottoms against fouling, extensive tests were reported by the paint committee, leading to the conclusion that cuprous oxide combined with yellow oxide of mercury is the best toxic.

Technical Papers

Sulphur in Structural Steel—The second step in the joint committee investigation of the effect of sulphur and phosphorus on steel was reported by Dr. George K. Burgess. It will be recalled *(Engineering News-Record* July 1, 1926, p. 26) that in the first step, rivet steel was found to be unaffected by sulphur up to 0.06 per cent, and but little affected even up to 0.18 per cent. Structural plate steel now is shown to be similarly unaffected up to the highest sulphur used, 0.08 per cent; (a curve plotting of the results will be reproduced in a later issue).

Work on forgings has been partly completed, but more tests are to be made. F. N. Speller urged that work on phosphorus be pushed, as rephosphorized pipe is being used increasingly for casing, because of its threading, welding and strength qualities.

Yield-Point of Structural Steel—A research committee of the society during the year has made extensive tests on structural-grade steel rods to compare methods of determining yieldpoint and variations between laboratories. Excellent agreement was obtained. Publication of detail results is deferred until similar tests on pieces from parts of steel shapes and plates are made.

Developments in Endurance Testing—As for some years past, important additions to knowledge of fatigue resistance were placed on record. This time they centered on metals other than steel: cast iron, duralumin,

aluminum, copper and its alloys, and cable sheaths of antimony-tin alloy. Qualitatively the results agree with those for steel (except for cable-sheath alloy, the first plastic metal studied in fatigue, which requires more investigation). The metals show a definite endurance limit, and have stress-cycle curves quite like those of steel. Where understressing or "coaxing" was tried, it improved the endurance. Notches lower the endurance limit of cast iron, though only slightly (a large lowering had been expected, on the score of relative brittleness). Corrosion lowers the endurance limit of most (but not all) of the metals, and, as for steel, simultaneous corrosion and fatigue are more harmful than fatigue following corrosion. Two striking observations were (1) that most metals show no greater endurance in corrosion-fatigue when tempered than when soft annealed, and (2) that a whole series of alloys may have about the same corrosion-fatigue limit in spite of the varying proportions of its constitutents.

Abstracts of these papers ("Effect of Corrosion Upon the Fatigue Resistance of Thin Duralumin," by R. R. Moore, of the U. S. Air Corps, McCook Field, Ohio; "Corrosion-Fatigue of Non-Ferrous Metals," by D. J. McAdam, Jr., of the Naval Engineering Experiment Station; "Tests of the Endurance of Gray Cast Iron Under Repeated Stress," by H. F. Moore and S. W. Lyon, of the University of Illinois; and "Fatigue Studies of Telephone Cable Sheath Alloys," by J. R. Townsend, of the Bell Telephone Laboratories, New York) will be published in a later issue.

Magnetic Testing of Physical Quality—Activity and rapid progress in magnetic testing of steel for physical quality was evidenced by four interesting papers on the subject. In one of these the routine magnetic inspection of steam turbine wheels at the works of the General Electric Co. was described by J. A. Capp. The method there used, an observation of change in magnetic permeability of the wheel material from point to point, has been successful in revealing hidden seams, hard spots and slag zones in the steel. An abstract of this paper will be published. Two quite different magnetic measurements were dealt with in the three other papers, presented as appendices to a committee report.

An instrument developed by J. A. Sams, also of the General Electric Co., measures the power loss which occurs in a small superficial area of the material under test when an alternating flux is set up by a small pencil-like electromagnet of concentric-pole construction, which at the same time carries an exploring coil. This coil measures the flux reactance voltage, whose component in phase with the magnetizing current represents the power loss. The device has been named Duroscope. It has been used for comparing the hardness of the several teeth of a milling cutter. Comparison of Duroscope readings with direct hardness measurement of a steel at various tempers showed roughly similar variations. This magnetic test is believed to involve only a thin surface layer of the test piece.

A highly sensitive analysis of hysteresis curves (instead of their integration as in the preceding) is utilized in a test method dealt with in "A Method of Graphic Representation of Magnetic Characteristics," by A. V. De Forest, of the American Chain Co., and "Magnetic Analysis by Means of the Cathode-Ray Oscillograph," by Thomas Spooner, of the Westinghouse Electric & Mfg. Co. This method is an improvement on a method previously described by Mr. De Forest.

Two samples of material, one known and the other to be examined, are placed in electric coils fed by alternating current; the difference between the induced voltages of the two coils is impressed on one pair of plates of an oscillograph and deflects its beam in one plane, while a sine-wave deflection at right angles to this plane is produced by the other pair of plates, either in phase with the magnetizing current or (through a phase-shifter) in any phase displacement. The beam of light thus draws a loop which represents the lateral projection of the rim of a cylinder irregularly truncated, the height of the cylinder at any point of the cycle being proportional to the flux difference in the two samples. The phase shifter enables the observer to turn this cylinder on its axis and see it from any side. The loops of light may be viewed or photographed. They greatly exaggerate small differences between the cyclic induction curves of standard and test sample, and apparently are not easy to interpret unless the two samples are alike. Mr. De Forest showed how the method is applied to routine inspection of drop-forged cutter blades of tire-chain nippers.

Mr. Spooner showed how the loops may be drawn by graphic construction from the induction curves of the samples, and gave results of their application to bars of high-speed steel which are being studied in a research project. He proved also that when the samples are so large that eddy currents distort the loops, lowered frequency (10 cycles in place of Mr. De Forest's 60 cycles) tends to correct the trouble.

Wear Testing—H. J. French, of the Bureau of Standards, under the title "Wear Testing of Metals," reviewed many experiences with wear-resistance tests. Metal-to-metal wear tests do not necessarily give the same results as tests in which an abrasive is introduced. Also, "wearing in" effects have been observed, differing widely for different metals. Unknown surface films sometimes form, producing erratic results.

Sheet Metal Tests—Extensive experimental work to develop tension tests of sheet metal was reported in three papers. J. C. Nichols, E. S. Taylorson and J. C. Whetzel, of the American Sheet & Tin Plate Co., compared seven forms of tension test specimens, finding only elongation to vary appreciably. They recommended that the gage length be not much less than 2 in. and preferably four times the width. R. L. Templin, of the Aluminum Co. of America, described the procedure found suitable for tests of aluminum. He proposed that the yield-point be located where the rate of elongation exceeds the initial rate by 0.015 times the modulus of elasticity in millions. Studies of test methods for sheet brass were reported by H. N. Van Deusen, L. I. Shaw, and C. H. Davis, of the Bell Telephone Laboratories, the Western Electric Co., and the American Brass Co., working in conjunction. They conclude that the basic mechanical test is the tension test, which should be used as reference test, but that under standardized procedure the Rockwell hardness tester is satisfactory for acceptance tests for brass thicker than 0.020.

Steel—Semi-steel with nickel content of 0.75 per cent or more gives tensile strengths of 55,000 to 65,000 and a breaking load of 5,400 to 6,000 lb. in bending (arbitration test bar), according to a paper by M. E. Greenhow. With nickel the iron was much softer and more ma-

chinable than without. T. D. Lynch stated that such iron is coming into use rapidly.

R. S. McPherran, of the Allis-Chalmers Co., reported high-temperature tests of a steel of 18.7 Ni and 7.2 Cr; he found a sharp ductility minimum at 1,800 deg. F., and recommended 2,200 deg. and 2,500 deg. as suitable temperatures for forging and upsetting. N. S. Mochel declared the latter figure too high and 2,100 deg. ample.

In "Embrittlement of Boiler Plate," Prof. S. W. Parr and F. G. Straub told of further studies at the University of Illinois on cracking and corrosion caused by alkaline boiler water (see *Engineering News-Record*, July 22, 1926, p. 151). High pressures were used in the past year's work. Some inhibitive chemicals were found.

Lime and Cement—Replacement of up to half the lime in a lime-cement brick mortar by half its weight of Celite (a diatomaceous silica) produces largely increased strength, both tensile and compressive, without particular change in workability or cost, according to a paper, "Improved Brick Mortars," by L. E. Weymouth, of the Celite Co., Lompoc, Calif. J. O. Draffin, of the University of Illinois, presented a study of tests made by Bates and Klein at the Bureau of Standards on the three main constituents of portland cement, and concluded that their strength curves may be added in proper proportion, to give an approximation to the strength curve of the corresponding cement, provided the separate values are adjusted for their accelerating action on each other.

A contribution to the question of magnesia in cement was made by P. H. Bates of the Bureau of Standards, in a paper reporting the ten-year strengths of high-magnesia cements made a number of years ago; the early strengths of these cements were given in a Bureau paper in 1918. The ten-year results confirmed the conclusions drawn from the earlier tests, namely that 6½ to 7½ per cent magnesia has no injurious effect on strength of neat cement, sand mortar or concrete.

S. E. Thompson and M. N. Clair, of Boston, gave the results of several hundred 24-hour tests of sand (to judge its suitability for concrete) using alumina cement to obtain early strength. Their conclusion was that the results are better indications of 28-day portland cement test results than are 7-day portland cement tests, and therefore have practical value.

Concrete—A series of papers on concrete, assembled by C. M. Chapman, who also introduced their presentation with a statement of the present-day problems of field control of concrete quality, formed the main feature of the closing session of the meeting. Much of the matter presented dealt with problems of the construction engineer, such as devices and methods of handling concrete, cold-weather precautions, and special treatment of joints. Field tests were discussed by two of the authors, open questions about mixers by another, and proportioning or design of mixtures by a fourth.

R. W. Crum, of the Iowa Highway Department, in "Proportioning of Concrete" compared the use of water-cement ratio and of void-cement ratio, applied to several series of compressive-strength tests, and found them equally satisfactory, and equally applicable to mixture design. He then showed from field experience that the actual proportions are subject to much variation, both as to water and as to aggregates. Water control is still very imperfect and needs constant checking. Weighing of aggregates has been found in Iowa to result in great gain in uniformity and saving in cement.

R. A. Nelson, of the University of Wisconsin, also dealt with mixture proportions, reporting a study carried out with B. F. Smith, under direction of Prof. M. O. Withey. The study related to a large series of co-operative tests made by four laboratories for the committee on concrete and concrete aggregates. It was found that the compressive strength is a function of either the water-cement, the void-cement, or the space-cement ratio, and that for water-cement ratio x the strength S may be expressed by the formula $S = 18000/10^x$, between the limits of 1,500 and 3,500 lb. per sq.in. This formula is slightly below Abrams' formula $S = 14000/7^x$. Fineness modulus, surface modulus and surface area of mixed aggregate were found to be equally suitable measures of effect of aggregate on strength.

"Mixing of Concrete," by D. A. Abrams, of the International Cement Corp., New York, pointed out that the action of mixing machines has not been fully explored. Blade placing, longitudinal travel and dropping have not been studied as needed. The influence of mixing time has been investigated with small mixers only. Central mixing has possibilities not yet fully realized.

Valuable hints on construction practice were given by N. L. Doe, of the Turner Construction Co., New York, under the title "Conveying and Placing Concrete." The author stressed the importance of preventing segregation in placing, and expressed strong preference for bottom-dumping equipment. Chuting has the advantage, he said, that it gives a check on consistency, since only concrete of right consistency can be chuted effectively. R. L. Bertin, of the White Construction Co., New York, brought together another group of experience teachings in "Construction Joints and Expansion Joints." F. H. McGraw, Dwight P. Robinson & Co., New York, dealt similarly with cold-weather concreting; he cautioned against sole dependence on anti-freeze admixtures, but warned also that when heating is used the need for moisture supply should not be overlooked.

On the subject of field tests, H. S. Mattimore, of the Pennsylvania Highway Department, described and advocated the transverse (cantilever beam) test for field control, showing its superior uniformity over the compression test by diagrams of Pennsylvania field results. R. B. Young, of the Ontario Hydro-Electric Power Commission, reviewed field test practice generally, with the conclusion that present standard methods are incomplete. Some valuable figures on the range of variation of concrete strengths on long and short jobs were included in his paper; they showed that the range increases with the length of the job up to 9 months or so, and may be subject to periodic variation on very large work.

A further concrete paper, presented in brief abstract as part of the report of the concrete aggregates committee, was by G. F. Laughlin, of the U. S. Geological Survey, outlining the main features of study of rock for concrete aggregates from the geological viewpoint. He brought out that serious errors in selecting stone have been made which could easily have been prevented by geological examination.

In the discussion of concrete, which was fully as varied as the papers, the transverse test was a leading subject. P. J. Freeman and J. G. Bragg told of the valuable service of the transverse test at Pittsburgh,

where it permitted opening many road sections in five days, and in New Jersey, where it led to reduction of cracking of pavement. Others cautioned against exclusive dependence upon beam tests, among them H. F. Gonnerman, who outlined the results of extensive comparisons with the compressive test in the Portland Cement Association laboratory last year. He found the two tests equally consistent, but the beam test with third-point loading gave regularly lower results (by 80 to 150 lb. per sq. in.) than with center or with cantilever loading, probably due to the larger section under maximum stress. If beam tests alone are relied on, he cautioned, pervious undersanded mixes may be approved, and check tests in compression will be of value. R. W. Crum, D. A. Abrams and others also cautioned against sole reliance on transverse tests, Mr. Crum referring to expansion failure of pavements as a case of compressive stress. Mr. Abrams advised going slow in calling the transverse test superior and suggested closer attention to testing technique, particularly in the compression test. L. W. Teller (Bureau of Public Roads) on the other hand agreed with many who held transverse strength to be more closely related to pavement design than compressive strength. He mentioned tests on 6 x 6 x 30-in. beams now in progress at Arlington as showing the need for adopting uniform procedure for transverse tests, in view of variations found to result, especially from rate of loading.

Central mixing, in Mr. Abrams' opinion, is hardly subject to limit as to distance; the often specified limit of 30 min. from mixture to work is probably not well founded; concrete may be benefited by holding. P. J. Freeman told of 40,000 cu.yd. of road concrete supplied from central plants, with maximum delivery times of 50 min. (satisfactory) and 75 min. (too long).

Other Materials—Considerable interest was developed by studies of erratic results of rubber tests reported by F. S. Conover and H. A. Depew, of the New Jersey Zinc Co., Palmerton, Pa., which revealed large effects of moisture variations. They recommended storing test material at constant humidity, preferably zero, but others thought a higher figure preferable.

M. E. Dunlap, of the Forest Products Laboratory, Madison, Wis., and F. P. Cartwright, of the National Lumber Manufacturers Association, Washington, presented a paper urging the society to develop test methods for fire-retardant-treated lumber. Review of existing test methods led them to believe these inadequate.

Two papers on asphalt also developed discussion. In "Low-Temperature Ductility of Filler-Grade Asphalts," W. F. Smith, of the Oklahoma highway department, reported that such asphalts often prove brittle in cold weather, for which reason a minimum ductility of 1½ to 2 cm. at freezing temperature should be required. The time factor in such tests and the difficulty of testing at freezing were brought out in discussion. J. H. Bateman of Louisiana State University and Charles Delp of the Louisiana highway commission described their method of extracting asphalt from paving mixtures and showed that its properties had been changed by oxidation in mixing.

Instruments and Test Methods—Prof. J. Hammond Smith described a new and highly sensitive autographic extensometer with step-by-step rotation of the cylinder. A simplified and very effective test for holes and weak spots in nickel plating, using sensitized paper, was described by K. Pitschner under the title "A Rapid and Practical Method of Applying the Ferroxyl Test to Protective Coatings." The paper shows brown spots where the holes in the nickel go to the copper base, and blue spots where they extend through the copper to the iron. F. A. Hull and G. J. Steele described practical materials-laboratory applications of the spectograph.

Society Affairs—During the year the society increased by 220 members. Its growth has been about constant for nine years, the membership increasing from 2,200 to 4,200. As the growth of activity is in greater ratio, however, larger income is needed. Last year an entrance fee was instituted, which resulted in a small surplus for the time being. This year's meeting approved an increase of dues for company members to $30, the individual membership remaining at $15. With larger income it is planned to build up a research fund by setting aside a sum each year, and a beginning has already been made by reserving $1,000 from last year's funds.

Officers elected for the coming year are: President, Prof. H. F. Moore, University of Illinois; vice-president, T. D. Lynch, Westinghouse Electric & Mfg. Co.; members of executive committee, F. O. Clements, General Motors Corp.; W. H. Klein, Dixie Portland Cement Co.; F. C. Langenberg, Watertown Arsenal; and F. N. Speller, National Tube Co.

The executive committee strengthened the rules governing committee procedure. It plans to promote extension of student membership, established only last year, to extend the society's influence. Participation in the International Congress for Testing Materials at Amsterdam in September was announced; nearly a score of American papers will be presented. The agitation for an international standardizing organization, however, has not yet obtained the support of the society, pending a clear definition of the needs and advantages of international engineering standardization and the proposal of definite and acceptable procedure for approval of standards.

Concrete Cradles Increase Pipe Support

The use of concrete cradles for large-size pipe conduits increases the supporting strength of the pipe to about one and one-half times that obtained when the pipe is laid in trenches in the ordinary manner. Bulletin No. 80 of the Iowa State College of Agriculture and Mechanic Arts describes investigations made on this subject by the Iowa Engineering Experiment Station in co-operation with the U. S. Bureau of Public Roads. Tests were made to determine the supporting strength of concrete pipe from 24 to 84 in. in diameter with different types of cradles, in order to enable the designer to choose the type of cradle best suited for a particular installation. These tests showed that the supporting strength of pipe with cradles is increased because of a wider and more uniform bearing afforded and because of the increased resistance to deformation of the pipe. A thicker cradle as well as one with higher sides was found to give the most supporting strength to the pipe. Reinforcing the cradle in a flat plane seemed more effective than curving it to parallel the pipe surface, although cradles without reinforcing were as effective as those with reinforcing.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

An Appreciation of John M. Goodell

Sir—Few people knew, I think, the man who has just passed on to that bourn from which no traveler returns. John Goodell was a man—a real man—a loyal friend, and one who knew not the use of disparaging remarks. He was kindly, sympathetic, moral, an untiring worker, caring nothing for material gain. The engineering profession has lost one of the dearest characters that ever lived. He was one of God's noblemen. GEORGE A. JOHNSON.

New York City,
June 23, 1927.

Joint Meeting Plan of Building District Sewerage Systems

Sir—The letter of Dr. Costill appearing in your issue of June 16 p. 996, is a clear justification for my written request that you publish my letter of April 18 substantially as I wrote it. This you did not do. The letter published in your issue of June 2 p. 913, purporting to be from me, entirely misconstrued the thought I had in mind when dictating the letter.

My letter was written basically as a protest against the attitude of *Engineering News-Record*, as expressed in a letter to me under date of Sept. 27, 1924, and again on Jan. 27, 1927, to the effect that the only thing of interest in such projects as the bringing together of eleven separate municipalities by voluntary joint action, epitomized, was a record of the amount of brick and mortar to be utilized, and its cost, and that until the brick and mortar flew, you were not interested in discussing the subject.

The first two deleted paragraphs of my letter are as follows:

"Two years ago, I received a letter from you stating that just as soon as the project was far enough advanced so that contracts were ready to be let, you would be glad to publish a news item concerning this project.

"Your desire to treat this matter merely as a construction news item indicates that your conception of the major importance of this enterprise substantially differs from mine, so that when recently you were asking me to give you a brief description of the project, in view of the growing necessity for joint municipal enterprises, I felt that it would be of greater general interest to outline some of the difficulties which had to be overcome in order to achieve a construction stage."

By the omission of the deleted paragraphs of my letter, you not only destroyed its value and completely changed its sense, but caused unnecessary annoyance, as evidenced by the protest letter of Dr. Costill.

The importance of the discussion of such voluntary joint municipal enterprises is, in my judgment, very timely, especially in view of the criticism of the North Jersey District Water Supply Commission, to the effect that they are not duly representative of the municipalities for whom they are executing such an important undertaking. The State of New Jersey is voting [will vote Sept. 20, 1927] upon a constitutional amendment extending the power of commissions to create sewerage and sewage disposal works districts wherein the individual municipality will lose its identity.

Dr. Costill has clearly brought out those facts, which from the context of my original letter would have been more readily recognized, namely, that the delays which were encountered prior to the approval of the State Department of Health were not attributable to negligence, procrastination or any other dereliction on the part of the department, but because of legislation and matters over which it had no control, but which were delays none the less expensive and objectionable to the contracting municipalities. The need of revisions in the laws upon this subject is a matter which I would recommend for serious consideration, for not only has the supplementary joint trunk sewer been delayed and hampered by laws difficult to work under, but other projects have also encountered similar difficulties.

My attendance at the American Water Works Association Convention and the press of engagement upon my return have prevented an earlier protest against the liberties taken with my manuscript. I feel that it should either have been printed as I desired it, or if this did not meet with the policy of your valued publication, it should have been returned and not published at all.

Trusting that you will be kind enough to publish this letter in its entirety, I remain, ALEXANDER POTTER.

New York City,
June 20, 1927.

[The paragraphs omitted from Mr. Potter's letter were considered to be in the nature of private correspondence. We omitted nothing as to the "joint meeting" plan.—EDITOR.]

Damage to Baker's Haulover Bridge

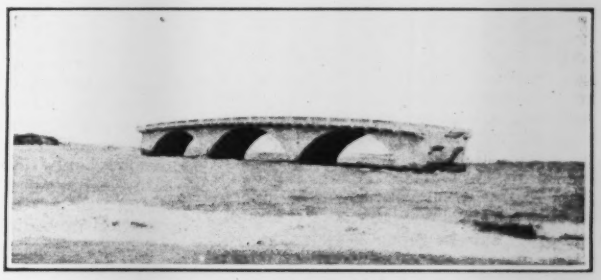
Sir—On p. 695, of your issue of April 28, is an article entitled "Sheet Piling Used in Repair of Bridge Approaches" which contains the statement:

"The abutments of a three-arch span concrete bridge crossing the inlet and connecting Miami Beach with Hollywood, Fort Lauderdale, etc., were washed out."

And in the same article is another statement:

"The bridge itself was not appreciably moved."

The bridge referred to is the Baker's Haulover bridge



three miles north of Miami Beach, Florida, on the Atlantic front. It passed through the hurricane of Sept. 18, 1926, and was not damaged although exposed to the full attack of the Atlantic Ocean. The approaches were washed away but the abutments were not affected and the bridge was not moved at all.

I enclose a view of the bridge after the storm. It spanned an inlet from the Atlantic to Biscayne Bay and now stands exposed in the ocean, the banks of the inlet having been widened from 250 ft. to more than 800 ft. by the wave action in the storm. DANIEL B. LUTEN,

Indianapolis, Ind., Designing and Consulting
June 16, 1927. Engineer.

Congestion and Traffic Accidents

A report recently made to the Public Safety Advisory Committee of the National Safety Council states, in brief, that there is no statistical relation between congestion of cities and street traffic accidents. As substantiating this statement, the report in its conclusion states that (1) the death rate per 100,000 population from all accidental causes decreases as the density of population increases in cities of 50,000 population and over; (2) motor vehicle fatality rates per 100,000 population have been increasing at about the same rate for larger cities as for smaller cities. The report indicates that accident prevention cannot be cited as one of the reasons for decentralizing our larger cities.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Mississippi Commission to Hold Hearings on Its Plans

The Mississippi River Commission plans to hold a series of hearings throughout the lower Mississippi River valley to consider matters connected with revision of plans, estimates of cost, and time of completion of the proposed work for the control of floods on the Mississippi River and its tributaries. Interested parties will be heard both verbally and by the presentation of written statements.

The first hearing will be held at Vicksburg on July 7 and the following hearings at New Orleans on July 8, at Memphis on July 9, and at St. Louis on July 11.

Am. Soc. C. E. Denver Convention Program Announced

The 57th annual convention of the American Society of Civil Engineers will open on Tuesday, July 12, in Denver, Colo., with a conference of local section representatives in the afternoon and evening. On Wednesday morning the convention will formally open. Thursday afternoon and Friday morning and afternoon will be taken up with technical papers and discussions presented at meetings of the City Planning, Highway, Irrigation and Surveying and Mapping divisions. Friday and Saturday will be spent in visiting and entertainment.

On Friday the convention moves to Colorado Springs, where an automobile ride has been arranged through the Garden of the Gods, followed by a dinner at Cheyenne Lodge. On Saturday a trip will be made to Pike's Peak by the cog-railway and by automobile.

Steel Mast Buckles While Razing New York Building

The buckling of a 75-ft. steel mast, used in razing a 10-story building on Canal St., New York City, resulted in the death on June 20 of a foreman and the injuring of several workmen.

The cause of the failure of the steel mast as given by the Manhattan Bureau of Buildings, was an attempt to remove a beam having one end embedded in a brick wall and not properly freed, which resulted in the mast buckling at a point about 5 ft. below its mid point and crashing to the floor of the sixth story, to which level the building had been razed. Failure was due primarily to the overload placed upon the mast in attempting to free the beam which caused several lattice bars in the mast to rupture. These bars may have been in a weakened condition.

The work is being done under the supervision of the Borough President's office and is a part of the program of extending Sixth Ave. to Canal St.

International Chamber Meets at Stockholm

Removal of Trade Barriers Appears As Dominant Topic—Geneva Conclusions Considered

By E. J. Mehren
Vice-president McGraw-Hill Publishing Company, Inc.

(By Cable)

Stockholm, June 28

The International Chamber of Commerce began its fourth meeting yesterday with 852 delegates from 41 countries present. Removal of trade barriers looms as the dominant topic, first because it is so important for Europe and, second, because the chamber itself initiated the study of this subject which formed the basis of a large part of the work of the recent International Economic Conference in Geneva.

The International Chamber of Commerce proposes to take up the Geneva conclusions. Its approval may be expected because the decisions made at Geneva accord, in the main, with the Chamber's own report. Backed by this official approval, the business men attending this meeting can go home and impress their responsible ministers with the need of legislative action to remove economic barriers.

Acting President Sir Alan Anderson pointed out in his opening address that individual governments will not act unless business shows that removal of their own barriers will be best for the national interests. These barriers are not merely tariffs; they include adverse treatment of foreign corporations, obstructions to transportation, prohibition of exports or imports and currency instability. Other subjects for discussion include patents; transportation by water, railroad and air; arbitration of international commercial disputes; international movements of capital; enforcement of foreign judgments.

America is well represented by 150 delegates under the able chairmanship of Owen D. Young. Among the delegates are W. W. Freeman, vice-president, Columbia Gas and Electric Co.; Philip H. Gadsden, vice-president, United Gas Improvement Co.; L. K. Comstock, chairman, L. K. Comstock & Co.; Roy D. Chapin, chairman, Hudson Motor Car Co.; John N. Willys, president, Willys-Overland Co.; Windsor White, chairman of the board, White Motor Co.; Norman H. Davis, of New York; Willis H. Booth, vice-president, Guaranty Trust Co.; John H. Fahey, past president, U. S. Chamber of Commerce; Julius Klein, director, U. S. Bureau of Foreign and Domestic Commerce; Fred I. Kent, vice-president, Bankers Trust Co.; Charles H. MacDowell, president, Armour Fertilizer Works; and William C. Redfield, Redmond & Co.

Special interest attaches to the German delegation. This is the largest of all, in spite of the fact that the Germans are attending for the first time.

To help American delegates with definite business objectives in Europe, the U. S. Department of Commerce has commercial attaches and trade commissioners here from London, Paris, Berlin, Brussels, Rome, Copenhagen, Warsaw, Helsingfors and Riga.

Explosion in Claremont Tunnel Injures Workmen

Twelve men, practically the entire crew at the heading, were injured by an explosion in the Claremont Tunnel of the East Bay Utility District on June 23. Three of the injured may die. The cause of the explosion is believed to have been methane, a natural gas, occasionally encountered in the Coast Range mountains.

The face was about 3,600 ft. from the portal of the tunnel when the accident occurred. The major portion of the injured crew were placing timber sets 40 or 50 ft. back from the face at the time of the explosion.

The tunnel is lighted electrically and is provided with an adequate ventilating system which should have been operating while crews were at work. There is a strict rule against smoking in the tunnel but some flash is believed to have been the means of igniting the gas. An investigation is being made by the State Industrial Accident Commission.

This is the same tunnel in which ten workmen were trapped and drowned on last Thanksgiving Day when a cofferdam near the portal broke and storm waters flooded the bore. An account of that accident appeared in *Engineering News-Record*, Dec. 30, 1926, p. 1091.

Plans Invited for Development of Port of Barcelona, Spain

Announcements have been received from El Consorcio of the free port of Barcelona, Spain, that competitive plans are invited for a port development, open to all persons whether natives of Spain or not.

A prize of 100,000 pesetas (about $19,000) and another one of 25,000 pesetas, will be awarded by a jury of "well-known persons in the engineering and building professions of Spain." The personnel of this jury will be published before the contest closes.

Plans made may be edited in either Spanish, French, English, Italian, German or Portuguese and must be submitted to "Excelentisimo Señor Comisario Regio del Consorcio, del Puerto Franco, Paseo de Circunvalacion, No. 1, Barcelona, Spain," before 12 p.m., Dec. 9, 1927. Plans may be submitted in foreign countries to diplomatic or consular representatives of Spain.

Montreal Typhoid Cases Pass 4,700 with Promise of Decline

The sixteenth week of the Montreal typhoid epidemic, like the week before, saw 92 cases reported, or an average of a little over 13 per day, according to information supplied to *Engineering News-Record* by Dr. S. Boucher, director of the Montreal Department of Health. On the first day of the seventeenth week only one case was reported, but on the following day, Saturday, June 25, there were ten cases. Press reports give no cases on Sunday (office closed) and 14 on Monday, up to 4:25 p.m. The total number of cases from March 3 to June 27 is 4,738 and the number of deaths from March 12, the ninth day of the epidemic, to June 25 is 441. On the afternoon of Monday, June 27, states the Montreal *Gazette*, there were 635 typhoid patients in 20 hospitals.

Engineering News-Record is informed by Alphonse Lessard, director of the provincial bureau of health, that Dr. H. D. Pease, of the Pease Laboratories, New York City, is assisting the bureau in an attempt to ascertain how the milk supplies to which the epidemic is attributed became infected.

Local Levee Boards Ask for Aid in Repairing Flood Damage

The Louisiana levee boards have asked the War Department to instruct the Mississippi River Commission to bear the expense of closing the breaks in the local levee system as the local boards are without funds. The Bureau of Public Roads also has been asked to provide funds for the rehabilitation of the roads washed out during the flood. The estimated cost of restoring the levees in the Louisiana region is placed at $812,000.

Snow May Pass Upon Wanaque Water Supply Controversy

The eight municipalities which contracted with the North Jersey District Water Supply Commission for a water supply from the Wanaque River were notified by the commission on June 24 that since John R. Freeman was unable to pass upon the points in controversy because he is about to go abroad, the commission has decided to engage for the purpose F. Herbert Snow, chief of the engineering bureau of the Pennsylvania Utilities Commission. The decision was reached "in conference" June 23 and was to come up for formal adoption, today, June 30, when, *Engineering News-Record* is informed, the official representatives of the municipalities will protest vigorously against the appointment of Mr. Snow because he was not one of the four engineers from whom it was understood three weeks ago that a choice would be made, and because Mr. Snow had been chosen by the commission without the knowledge of the municipalities that his name was under consideration.

A lengthy abstract of the engineering reports in controversy appears on p. 1062 of this issue.

Engineering Fifty Years Ago

From *Engineering News*, June 30, 1877

G. F. DEACON, borough surveyor of Liverpool, England, has published a paper on Portland cement . . . which contains records of trustworthy experiments. . . . Mr. Deacon made a test block which was of less section in the middle than at the ends, but was without corners or sharp curves in any part. More than 500 experiments were tried with his and the London block (made with square sides except in the central part, to which the test was supposed to be applied, and where, for about one-fifth of the length of the block the form suddenly became concave). It was found that while a block of the London pattern would indicate a breaking weight of 647 lb. for a section of 2¼ sq.in., seven days after gagging, the Liverpool block would give a strength of 753 lb., or an additional strength of nearly 16 per cent. From this it becomes plain that it is not sufficient in specifications to prescribe a certain degree of strength as requisite for Portland cement, unless the form of the test block is likewise stipulated.

A.G.C. Offers Prize Cups for Safety Work

Rules have been formulated for the prize cup competition sponsored by the Associated General Contractors. Through the courtesy of William F. Tubesing, president of the William F. Tubesing Co., Milwaukee, Wis., a silver cup is offered as a prize to the member having the best accident prevention record during a given period; also, the Robert L. Reisinger Co., of Milwaukee, Wis., will donate a Milwaukee Chapter cup to the chapter of the Associated General Contractors whose accidents average the lesser amount for a given period on man-hours lost against man-hours worked. These prizes are to be awarded under the following rules:

1. These contests shall begin July 1, 1927, and continue until the close of 1927. Thereafter they shall be on a calendar year basis.

2. All chapters and all individual members of the Associated General Contractors in good standing are eligible to enter the contest for either respective cup. No individual member shall enter the contest for the Tubesing cup if a member of a chapter which has entered the contest for the Milwaukee Chapter cup.

3. A lost-time accident shall be any personal injury arising out of and in the course of employment which causes loss of time beyond that day, turn or shift during which the accident occurred. If the man returns to work during that day, turn or shift, or at the beginning of the next, the accident shall not be counted as lost time.

4. In order to insure a uniformity of reports, so that they may be compared, forms must be similar to those used by the National Safety Council, 108 East Ohio St., Chicago, Ill., and used either by individual members or by chapters.

5. A monthly summary of the experience of each chapter or member as the case may be shall be mailed on proper forms to the headquarters of the Associated General Contractors of America, 1150 Munsey Building, Washington, D. C., not later than the 20th day of the month immediately following.

6. Each chapter entering the contest shall compile for all of its members and each individual member entering the contest shall compile for its company the following data: (a) Average number of employees; (b) total man hours worked by such employees. (To obtain this, add the total hours worked during the month by each employee on the payroll); and (c) total number of lost time accidents occurring during the month in accordance with Rule 2.

7. The winner in each case shall be the chapter or the individual member having the lowest severity rate, i.e., the lowest percentage of man-hours lost per thousand man-hours worked for the period outlined under Rule 1.

8. The Accident Prevention Committee of the Associated General Contractors of America shall be the judges of the records submitted by the various chapters and individual members entering this contest and shall award the two cups under these rules.

9. The awarding and presentation of each cup shall take place on the last day of the annual meeting, 1928, and thereafter on the last day of each annual meeting as necessary. The Tubesing cup becomes the permanent possession of the individual member winning it two consecutive years and the chapter cup becomes the property of the chapter winning it three times, whether consecutively or not.

10. All chapter and all individual members entering these contests shall notify the Associated General Contractors of America, Washington, D. C., not later than June 30, 1927.

Propose to Dam Colorado River in Arizona

The board of directors of state institutions of Arizona has filed an application with the Federal Power Commission covering a section of the Colorado River in the region of Parker. It is proposed to build a dam to raise the river to a level of 90 ft. This will create a reservoir of 1,900,000 acre-ft. capacity. The powerhouse is to be built on the Arizona side of the river where an installation of 200,000 hp. is proposed. Some 100,000 hp. of primary power would be developed.

The application is in conflict with previous applications by the Beckman and Linden Engineering Corporation, San Francisco, Calif.; the city of Los Angeles, and the Southern California Edison Co. No action will be taken on the application as all action on projects in the basin has been suspended.

Washington Notes

A FORMAL resolution opposing the development of power at Great Falls on the Potomac River was adopted June 20 by the National Capital Park and Planning Commission. Members of the commission, after a day spent in traversing the site of the reservoir above Chain Bridge, came to the conclusion that Great Falls and the gorge below the falls should be preserved for park purposes. It was held that the development of power would destroy the chief scenic values.

In this connection the point is made that the commission or no other agency has concerned itself with the beauty of this area heretofore. For a very small amount of money, it is pointed out, the area could have been cleared of stagnant water and unsightly underbrush. Attention also is called to the fact that no such obstacle was placed in the way of Senator Norris' proposal to have the project built and operated by the government. But now that a private corporation makes a similar proposal there is a sudden realization that scenic beauty may be marred.

AN APPROPRIATION of $2,000,000 annually for five consecutive years has been asked by the National Capital Park and Planning Commission for the acquisition of parks, parkways and play grounds in the District of Columbia.

SAVANNAH River Electric Co. of Greenwood, S. C., has applied to the Federal Power Commission for a license covering a project on the Savannah River in McCormick County, S. C., and Columbia County, Ga. The proposed dam is to be 90 ft. high and 4,200 ft. long. As planned, 34,560 hp. of primary power will be made available, but 120,000 hp. will be installed.

WORK is to begin in the near future, it has been announced by Charles S. Dewey, the assistant secretary of the treasury, on the government's large building program south of Pennsylvania Ave. in Washington. Work will be begun first on a central structure which will unite two Agricultural Department buildings which are now standing alone. The construction of the Internal Revenue Bureau building will be begun next, it is expected, with prospects favoring the building for the Department of Commerce being next in order.

AS A PART of the effort to bring agriculture to a higher plane of efficiency American Engineering Council, in co-operation with the American Society of Agricultural Engineers, is engaged in an endeavor to set up a bureau of agricultural engineering in the Department of Agriculture. The division of rural engineering of the Bureau of Public Roads is to be the basis of the new bureau. The plan has been endorsed by the Secretary of Agriculture. A bill providing for this change will be introduced upon the convening of Congress.

Staff for Teachers' Summer Schools Announced

Engineering Foundation, New York City, has announced the names of the teachers and subjects for the summer schools for engineering teachers at Cornell and Wisconsin universities beginning July 6. Both schools will be conducted under the joint auspices of the Foundation and the Society for the Promotion of Engineering Education. The registration for the session at Cornell has been closed, as the maximum number who can be accommodated has been reached. The enrollment for Wisconsin soon will be closed.

Dean Dexter S. Kimball of Cornell will be director of the summer school for engineering teachers at Cornell, and Prof. E. R. Maurer, head of the department of mechanics at Wisconsin, will head the summer session at that institution.

Teachers chosen for the Cornell school are: Prof. C. M. Allen of Worcester Polytechnic Institute, Prof. Vladimir Karapetoff of Cornell University, Dean Milo S. Ketchum of the College of Engineering, University of Illinois; Stephen Timoshenko, research engineer of the Westinghouse Electric & Manufacturing Co.

Among the members of the Wisconsin lecture staff will be: Prof. A. P. Poorman of Purdue and Prof. S. M. Woodward of Iowa State University. Teachers at Wisconsin will be Prof. H. F. Moore of the University of Illinois, Prof. W. O. Withey of the University of Wisconsin, Prof. Edward Bennett of that university, Prof. O. A. Leutwilor, University of Illinois; Dean C. S. Slichter, F. E. Turneaure, Prof. E. M. Terry and Prof. Curtis Merriman, all of Wisconsin.

Northern Pacific Railway to Build 62 Mile Line in Montana

The Northern Pacific Railway Co. has been authorized by the Interstate Commerce Commission to build an extension of its Glendive-Sidney branch from a point about two miles west of Glendive in a northwesterly direction to Circle then southwesterly to Brockway, a distance of approximately 62 miles, all in Dawson and McCone Counties, Mont. The grade for the entire line will be about 1 per cent and the maximum curvature will not exceed 8 deg. The cost is placed at $2,546,556.

Indianapolis Adopts, 3 Cities Reject, Manager Plan

Indianapolis voters declared for the commission-manager plan of government on June 21 by about 52,000 ayes to 9,800 noes. The plan will not go into effect until Jan. 1, 1930, recent state legislation, evidently in anticipation of the adoption of the plan, providing that all city officials shall serve out their terms. At Charleston, S. C., on June 15 the manager plan was defeated by 2,902 noes to 543 ayes. Atlanta, Ga., defeated it May 25 by about 4,100 votes out of a total cast of about 11,900, as did Long Beach, N. Y., on June 10 by 1,063 to 133.

Random Lines

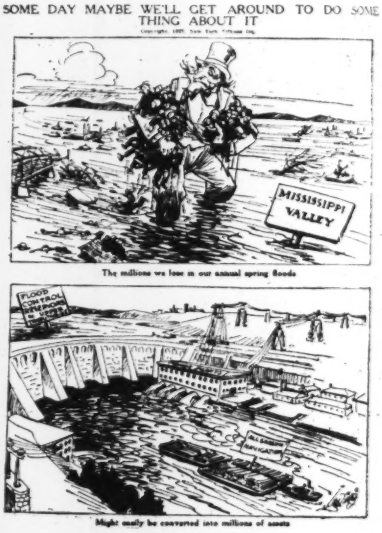
Flood Prevention

Another way of preventing floods in the Mississippi Valley is suggested in a letter to the *Gazette-Times*, Pittsburgh. The author suggests that all the Boy Scouts help by planting "apple or cherry seeds or nuts along roadsides or out-of-the-way places to hold their share of moisture instead of its speeding to some river bed. Each boy would enjoy drilling a pocketful of oats with a stick (primitive plow) along the edge of woods and forests whose stalk would catch their share of rain drops. Another means of checking the rushing flow of water would be little dams they could place in streams and watercourses. A gigantic conservation dam at headwaters would hold or check but little of the destructive waters compared to thousands of the Boy Scout retainers from the mouth to source of river. Then what a suggestion of power to the budding engineer."

* * *

Flood Control and Power

One of the flood-control reservoirs proposed for the Mississippi River is shown in the accompanying cartoon from the *Herald-Tribune*, New York. The details of the dam and power house


SOME DAY MAYBE WE'LL GET AROUND TO DO SOME THING ABOUT IT
MISSISSIPPI VALLEY
The millions we lose in our annual spring floods
FLOOD CONTROL RESERVOIR
Might easily be converted into millions of assets

are worthy of study by engineers. The lumber on the barges in the foreground apparently is a byproduct of the deforestation criticised by the same artist in the cartoon published in these columns May 12.

* * *

Contracting Always Has Been a Hazardous Business

"I asked him his name; he replied Abdulla, surnamed el Nahabi. . . . The Hejaz Railway was being built, and to its works he had come in search of fortune: but a contractor docked his wages for sleeping at noonday. He retorted by docking the contractor of his head."—From "Revolt in the Desert," by T. E. Lawrence.

Personal Notes

JOHN F. LYLES, formerly with the Mississippi River Commission, has been appointed engineer for the Oklahoma State Conservation Commission, with headquarters at Wagoner, Okla.

CHARLES HANSEL, consulting specialists, is the name of the new organization developed by Charles Hansel, formerly consulting valuation engineer to the Pennsylvania R.R. System, the Central Railroad of New Jersey, and the Reading system, and advisory engineer, formerly with office in New York City. The new organization has its offices in the Transportation Building, Washington, D. C., with an office at 143 Liberty St., New York. Its work is consultation for railroads, utilities and industrials, in the fields of valuations, recapture, rates, and income and other taxes; and it will also deal with problems in general engineering and other engagements. Its group of expert professional men is collecting records bearing on regulatory legislation and on important regulatory matters to add to the value of the consulting service of the organization.

JOHN R. FREEMAN, consulting hydraulic engineer, Providence, R. I., and past-president of the American Society of Civil Engineers, received the degree of doctor of science from the University of Pennsylvania on June 15.

D. W. JOHNSTON, former municipal engineer of Saanich and South Vancouver, B. C., has been appointed municipal engineer of Burnaby, B. C., to succeed E. R. Smith, who has been appointed district engineer in the provincial Department of Public Works, for the Prince Rupert district. Mr. Johnston was municipal engineer of Point Grey from 1908 to 1914, leaving to take a similar position at Saanich.

OTIS E. HOVEY, assistant chief engineer of the American Bridge Co., has been made a doctor of engineering by Dartmouth College. This is the first degree of the sort to be conferred by Dartmouth. SYDNEY E. JUNKINS, contractor and engineer of New York, also received from that institution a doctorate of engineering.

C. E. PUTNAM, present construction engineer of the Washington State Highway Department at Olympia, Wash., has been appointed assistant highway engineer by Samuel J. Humes, state highway engineer. He will be succeeded by O. A. PIPER, civil and construction engineer of Seattle, who for thirteen years was connected with the city engineer's office.

WILLIAM H. LYNCH has been selected to succeed James C. Wonders, as district engineer for the Bureau of Public Roads at Omaha whose death was noted in these columns recently. Mr. Lynch was graduated as a civil engineer from Lehigh University in 1905. Before joining the staff of the Bureau of Public Roads in June, 1913, he had seen service with the Hagerstown and Meyersville Electric Railway Co., in connection with the subway construction in New York City and as assistant engineer of the Pennsylvania Highway Department.

COMMANDER RICHARD E. BYRD, who made the flight over the North Pole last year and who began on June 29 a transatlantic flight, received from Virginia Military Institute on June 15 the degree of civil engineer.

FRED E. SWINEFORD has been appointed chief engineer of the Bureau of Maintenance of the Ohio State Division of Highways, effective July 1, succeeding George E. Carr, who has resigned to take up other work. Mr. Swineford has been division engineer of Division 4 of the Ohio state system, with headquarters at Ravenna, Ohio. His successor in that position will be L. A. BREEN, the present assistant division engineer of Division 4.

EMMET L. GREENE, former vice-president and general manager of G. F. Young, Inc., civil and landscape engineers, Tampa, Fla., announces the opening of an office in Dearborn, Mich., for the practice of civil engineering, specializing in municipal utility design and golf course engineering. His temporary address is Hawthorne Valley Golf Club, Dearborn, Mich.

J. W. SEENS has been appointed president and general manager of the Canadian Bridge Co., Ltd., Walkerville, Ont. Mr. Seens was formerly vice-president of the company. He is a native of Ohio, and a graduate in civil engineering from the University of Michigan, in 1901. He joined the staff of the Canadian Bridge Co. immediately after graduation but his connection with the company was interrupted by several years as city engineer of Grand Rapids, Mich., and with the Structural Steel Co., Ltd., Montreal. He has been continuously with the American Bridge Co. since 1920, being made a director in 1922 and vice-president in 1926.

GEORGE F. PORTER, formerly chief engineer of the Canadian Bridge Co., Walkerville, Ont., has been appointed consulting engineer of the company. He has been with the company since its organization in 1900. C. M. GOODRICH, formerly designing engineer of the company, has been appointed chief engineer. F. H. KESTER, formerly contracting engineer, has been elected a director and vice-president. A. E. WEST, formerly manager of construction, has been appointed operating manager. Mr. Goodrich joined the company in 1901, Mr. Kester in 1907 and Mr. West in 1911.

STEVENS & WOOD, Inc., 120 Broadway, New York City, designers and constructors of the Toronto Super-Power Station, announce the opening of a Chicago office at 53 West Jackson Boulevard, in charge of Lucien I. Yeomans. Mr. Yeomans has long been prominently identified with the engineering profession, especially in connection with coal distillation in which he will continue to specialize.

D. H. BRAY has been appointed assistant district engineer under G. L. Logan, district engineer of the Kentucky State Highway Department's sixth engineering district. Mr. Bray is a graduate of the University of Missouri. He entered the service of the Kentucky State Highway Department in 1920, and has served with that organization successively in the capacity of draftsman, instrumentman, and resident engineer. He started his engineering work as a rodman with the St. Louis-San Francisco R.R.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, New York City; Annual Meeting, Orono, Maine, June 27-30, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Summer Meeting, Denver, Colo., July 13-16, 1927.

The San Francisco Section of the American Society of Civil Engineers held its regular bi-monthly meeting, June 21, at which four papers were presented as follows: "Structural Features of Ames-Harris-Neville Factory and Warehouse," by Edward M. Knapik; "Penstock of the Bucks Creek Project," by Oswald Speir, Jr.; "Disposal of Sewage and Industrial Waste and its Relation to Stream Pollution," by Chester G. Gillespie; and "What Other Cities are Doing in Sewage Purification," by Walter C. Roberts.

The Illinois Association of Sanitary District Trustees held its annual meeting at Elgin, Ill., June 8 and 9, at which John W. Harber, Bloomington, was elected president for the coming year, and Gus H. Radebaugh, Urbana, was re-elected secretary. The organization announces that its 1928 meeting will be held at Bloomington.

Obituary

CHARLES W. BRYAN, chief engineer of the American Bridge Co., died at his home in New Rochelle, N. Y., June 25, aged 64 years. An extended obituary will appear in these pages in the issue of July 7.

CHARLES F. RAND, New York City, mining engineer and mine owner, and former chairman of the Executive Board of Engineering Foundation, died June 22 at his home in West Orange, N. J., at the age of 70 years. Mr. Rand had been identified with the construction of railway and the opening up and operation of iron mines in Cuba and with interests in managanese and copper mines. He also owned and operated iron mines in the Lake Superior district. He was a leader in metals research work both in his own companies and in connection with the work of the American Institute of Mining and Metallurgical Engineers, of which he was a former president, and the American Society for Testing Materials. He was born in Maine in 1856.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

Metal Lath Makers Report on Simplification Program

Metal lath producers met on June 17 under the auspices of the Division of Simplified Practice, Department of Commerce, in an annual revision conference on metal lath. A special committee was appointed to investigate the standardization of weights of the ⅜ rib lath with a view to reaching a unity of three varieties. The committee consists of W. C. Conger, chairman; E. H. Jones and J. A. Pfeiffer. Certain varieties of the flat expanded metal lath, the ⅜ rib expanded lath and the flat rib expanded lath were adopted as standard with others noted as specials.

WEIGHTS PER SQUARE YARD OF RECOGNIZED STANDARD METAL LATH

—Flat Expanded Metal Lath—			—⅜ Rib Expanded Metal Lath—			—Flat Rib Expanded Lath—		
Painted	Special Metals	Galvanized	Painted	Special Metals	Galvanized	Painted	Special Metals	Galvanized
2.5	2.5	2.5	3.0	3.0	...	3.0	3.0	....
2.2	*2.2*	...	*2.50*	...	...	*2.75*	...	*3.6*
3.0	*3.0*	...	*2.75*	...	3.6	*4.0*	...	....
3.4	3.4	3.4	*3.4*	...	...	.....	...	....
....	....	.	4.0	4.0	...	3.4	3.4	....

It was the unanimous opinion that these specials (shown in italic in the table) should be eliminated during the ensuing year.

All types of lath are to be specified and sold by weight per square yard. Metal lath in all types and weights galvanized after fabrication is to be eliminated.

Those attending the meeting were W. C. Conger, Guston Kahn, G. G. Travers and E. F. O'Brien of the Truscon Steel Co., Youngstown, Ohio; H. R. Colwell, Department of Commerce; M. C. Brown, Berger Mfg. Co., Canton, Ohio; E. H. Jones, Milwaukee Corrugating Co., Milwaukee, Wis.; Clay Wharton, Associated Metal Lath Manufacturers, Chicago; E. V. Spinosa and George Dorph, Penn Metal Co., Parkersburg, W. Va.; W. B. Turner, General Fireproofing Building Products, Youngstown, Ohio; P. H. Bates, Bureau of Standards; W. W. Galbreight, Youngstown Pressed Steel Co., Warren, Ohio; T. R. Herbert, Consolidated Expanded Metals Co., Wheeling, W. Va.; and L. G. Powell, Bostwick Steel Lath Co., Niles, Ohio.

Steel Dumping Charges Not Substantiated

No evidence having been obtained to support a suspicion of dumping, the Treasury Department has ordered collectors of customs to release appraisement reports on steel rails imported from Germany and the investigation as to dumping has been dropped.

This investigation was ordered by the Treasury last March following a complaint from a domestic producer of steel rails that an importation of rails from Germany for the Boston & Maine Railroad was at a price below the market price in Germany and hence violative of the anti-dumping law. Investigation among other producers of steel rails in this country, however, failed to substantiate the suspicion and the complaint was withdrawn by the company which filed it.

Compressed Gas Manufacturers' Association Meets

At the summer meeting of the Compressed Gas Manufacturers' Association, Absecon, N. J., June 16-18, members were urged to maintain the high ethical standards that exist in the industry, and to continue to extend their activities in improving work in progress. Stress was laid upon the importance of developing lighter and cheaper containers without altering standards of strength and efficiency. It was recommended that a handbook of technical data used in the compressed gas industry be published by the association, that standard cost accounting methods, particularly with reference to depreciation be developed by the association, and that standardized practices in handling transportation equipment be formulated and made effective. F. R. Fetherston was elected secretary-treasurer to succeed John H. Luening, who is to be associated with the Kentucky Oxygen-Hydrogen Co., Louisville, Ky.

Floods Reduce Tie Production

That production of railroad ties will be affected materially by the great flood in the Mississippi Valley is evident from an investigation reported in the May number of the *Cross Tie Bulletin*, official organ of the National Association of Railroad Tie Producers. There will be some loss of stock in lumber yards and in the woods, but the greatest effect will be the general flooding of the country and the difficulties of getting ties out of the woods and transported over softened roads to inspection points. The labor supply is also a problem, as there may be a general exodus, while farm and rehabilitation work after the flood will absorb a large proportion of the available labor. On the whole, there are prospects of a shortage of seasoned ties and an increase in prices.

Business Notes

BYERS MACHINE CO., Ravenna, Ohio, announces the appointment of E. L. Kelzer as district sales manager for the Pacific Coast and adjacent states, with headquarters at San Francisco. Mr. Kelzer will also serve in like capacity for the Owen Bucket Co., Cleveland.

WILLIAM OGDEN, for the past five years with the Lakewood Engineering Co., has accepted a new position as manager of the state highway division of the Austin-Western Road Machinery Co., Chicago.

MIXER MANUFACTURERS BUREAU of the Associated General Contractors announces that the Foote Company, Inc., Nunda, N. Y., has been elected to membership. It also announces that the Kwik-Mix Concrete Mixer Company has been suspended from membership for violation of the established concrete mixer standards. Fifteen companies now are members of the Bureau.

HYMAN-MICHAELS CO., Chicago, has appointed Hofius Steel & Equipment Co., Seattle, Wash., its representative in Washington and the northwestern territory.

LINK BELT CO., Chicago, announces that R. P. Shimmin has been appointed assistant to the chairman and the president, and that Frank B. Caldwell has been appointed sales manager, having supervision over all sales activities in the western division.

C. O. BARTLETT & SNOW CO., Cleveland, recently established a new district office at Pittsburgh in charge of W. C. Schade.

LESLIE H. ALLEN, who for the past three years has been general manager of the Hawthorne Roofing Tile Co., Cicero, Ill., and the Concrete Tile Machinery Co., Cicero, has resigned these positions and accepted the appointment of president and general manager of the Hawthorne Roofing Tile Company, New York City. Prior to his connection with the Hawthorne company, Mr. Allen was for three years with the Portland Cement Association, Chicago, and for eleven years with the Aberthaw Construction Co., Boston.

MUNDY SALES CORP., New York City, announces the appointment of the following distributors: Johnson-Beckwith Equipment Co., Davenport, Iowa, for eastern Iowa and the Mississippi River border counties in Illinois; and the Funkhouser Equipment Co., Kansas City, Mo., for Kansas, Oklahoma and western Missouri.

FOOS GAS ENGINE CO., Springfield, Ohio, announces a change in name of the company to the FOOS ENGINE CO. At the meeting of the board of directors the following officers were elected: president, J. F. Baker, and secretary-treasurer, M. E. Baker. Appointments made were: sales manager, R. C. Burrus; chief engineer, W. W. Schettler, and mechanical engineer, G. F. Noltoin. The company also has established a new factory branch at Tulsa, Okla.

HARRIE R. WILLIAMS, sales manager, General Excavator Co., Marion, Ohio, has announced his resignation effective July 1, to become general sales

manager of the C. F. Seabrook Co., Inc., New York City, distributors of contractors' equipment for the Eastern, Atlantic and New England States.

JACOB B. BLAW, who died recently at Atlantic City, was the original patentee of collapsible steel forms and it was on one of his patents, issued in 1903, on which the Blaw-Knox Co., Pittsburgh, then known as the Blaw Collapsible Steel Centering Co., was started. He resigned all connection with the company and disposed of his interest in it in 1910. Mr. Blaw was a remarkably aggressive man, with a personality typical of patentees who conceive of new ideas. After leaving the Blaw-Knox Co., he devoted his time to the development of new ideas along other lines in which he was quite successful.

New Developments

Light Joists of Steel and Wood Have Many Advantages

A standardized shop fabricated joist made of steel and wood and known as the Massillon light joist has recently been placed on the market by the Macomber Steel Co., Canton, Ohio. This joist is designed to be used in place of wood joists wherever wood joist construction is acceptable and is not to be used where Massillon bar joists for fireproof floor construction are properly adaptable. Although the light joists do not provide fireproof floor, they nevertheless are said to afford a high degree of fire resistance.

A lumber nailing strip and a structural angle fastened together with bolts and lag screws form the top member, while the web and bottom chord are bars electrically welded to the top member and end bearing angles to form a solid structural unit. Floors using these joists are built in the same manner as wood joist floors, the joists being supported on any type of wall or partition. They frame equally well with wood or steel beams. Other advantages claimed for this type of joist are that it eliminates the shrinkage and warping found

in wood joist floors, eliminates cracking of plaster, results in less deflection and less vibration than wood joist floors, and permits, because of its open web system, special facility in placing piping and conduits. Standard stock joists are available for prompt shipment for all spans from 5½ ft. to 23½ ft. Weights per piece vary from 28 lb. to 100 lb.

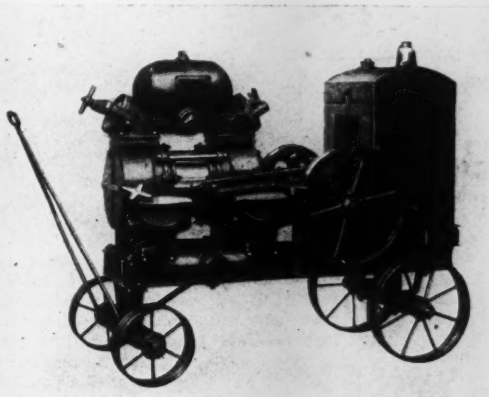
New Trench Brace

A new line of Simplex trench braces and fittings has been announced by Templeton, Kenly & Co., Ltd., Chicago, Ill. The new trench brace is made of steel and malleable iron complete with pipe. It is equipped with ball and socket joints at each end. The brace is adjustable to any width by the substitution of different lengths of pipe. The fittings are furnished to contrac-

tors who wish to put on pipe to suit themselves. The addition of a piece of standard gas pipe, cut to the required length with a small hole drilled in one end to receive a cotter pin, completes the brace in this case.

New Lift and Force Trench Pump

A new drainage pump designed for four-inch suction and discharge and supplied for either single or double suction is a new product of the Humphryes Mfg. Co., Mansfield, Ohio. An especially large air chamber is used in the discharge manifold to relieve any strain. One of the main features of the



pump is the horizontal outside packed brass cased plunger. The use of this plunger is said to eliminate any of the troubles experienced with diaphragms, while the outside packed feature enables the operator to keep the packing tight without stopping the pump.

The unit is suited for handling large amounts of solid matter and may be used for handling sewage and sludge in addition to general drainage work. The rotating rubber ball valves are easily accessible and can be removed without the use of a wrench or tool. The pump has a capacity of 250 g.p.m. and has a guaranteed suction lift of 25 ft. It is recommended for work having a maximum lift and head up to 50 feet.

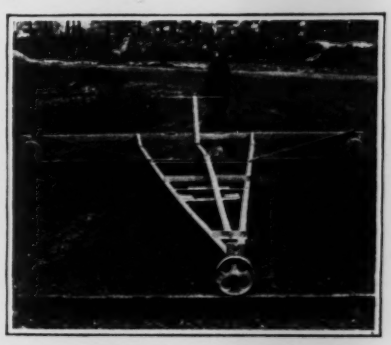
These force and lift type pumps are not only suited for open work but solve many drainage problems where water must be delivered beyond the pumps. The pumps are regularly equipped with one line of suction but double suction connections can be provided. The pump is powered with a two cylinder LeRoi engine. The unit is 6 ft. 9 in. overall and weighs 1,875 lb.

Gas-Electric Locomotive for Construction Service

A gas-electric locomotive has recently been developed by the Davenport Locomotive Works, Davenport, Iowa. It is claimed that the locomotive will start a heavier train than any steam or gasoline locomotive of the same weight. In principle, a generator connected directly to a gasoline engine furnishes electric current for the electric motors that are applied to each axle, all of the wheels being drivers. A street car type controller is used. The advantages claimed for this class of locomotive are smooth acceleration, close speed regulation and instant starting. The locomotives are made in 8, 10, 12, 16, 20 and 24 ton sizes for all track gages. The three smaller sizes have four wheels and the larger sizes have two four-wheel trucks.

New Longitudinal Joint System Developed

Controlling cracks in concrete roads by building-in planes of weakness has been used in a number of instances and the accompanying photographs illustrate one of the machines developed in this connection. In this system the weakened plane is as usual a longitudinal center joint and consists of a steel plate not more than one-third the thickness of the slab and of a groove left in the top of the slab about 1 in. deep. The slab usually develops a crack from the bottom of this groove to the top of the plate, but otherwise the slab is claimed to remain intact. The steel plate is placed at the time the forms are set. After the concrete has been poured and the road finished, the grooving is done by the edging machine shown in the photograph. At the same time the grooving is done the concrete may be floated, the machine shown providing a



float 6 in. wide. By this means a traffic mark 6 in. wide with a black center line is provided. The final operation consists in placing a filler material in the groove. The machine illustrated is one

of the first developed and does not include the mechanical means for raising and lowering the grooving and floating device which is a feature of the latest models. This machine and method has been invented and developed by J. W. Heltzel, assistant general manager, Heltzel Steel Form & Iron Co., Warren, Ohio.

New Freight Cars for Shipments of Unusual Size

The construction of a number of flat cars of special design has been arranged for recently by the Pennsylvania Railroad. The cars will have a carrying capacity of 275,000 lb. and have been built particularly for shipments of armatures, turbo-generators, transformers and large castings. The cars will be built with depressed centers, this central depressed portion 25 ft. long and 6 ft. 8 in. wide between the side sills, carrying the bulk of the shipment. The height of the car has been kept at a minimum in order to locate the center of gravity of the car and its load as low as possible. The length of the car body is 52½ ft. Six-wheel trucks, weighing about 105,000 lb., will be used.

New Threadless Pipe Coupling Has Many Advantages

A new threadless pipe coupling has recently been developed by George H. Snell Co., Attleboro, Mass., for which the following are some of the advantages listed: Saves cutting threads in trenches; saves using unions; does not require so large a trench; and pipe does not have to be in line. The

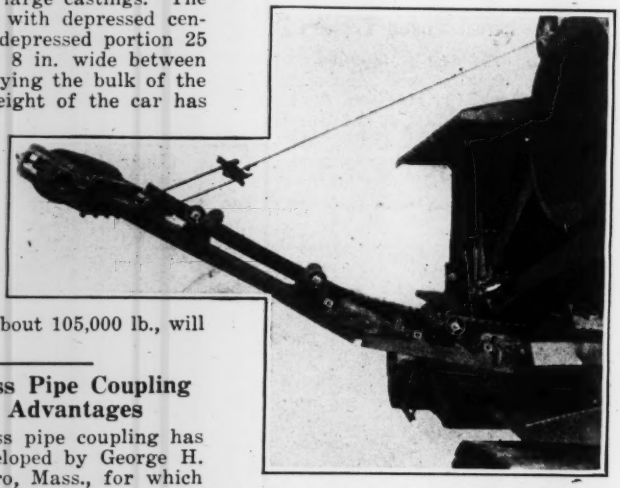
couplings are also very satisfactory to use for meter connections merely placing a plain nipple in the meter and attaching the coupling. On road building work, a coupling or a similarly designed tee can be inserted at any point with much less trouble than putting in an ordinary tee or union. The couplings are made in standard sizes of wrought pipe for pipe sizes of ½ to 4 in.

Special Body for California Highway Maintenance Work

In order to provide a 1½-yd. low-mounted power dump truck a body has been specially constructed by the equipment department of the California Highway Commission for maintenance purposes. The body is 66 in. wide, 105 in. long, and 9 in. high. The bottom of the body is 37 in. from the ground which allows materials to be handled from and to the truck by hand-shovel methods. It is equipped with an underbody hydraulic hoist which gives an especially acute dumping angle. The end gate hanging permits of regulation as to width of opening so as to secure uniform spreading. This information was supplied by R. H. Stalnaker, equipment engineer, California Highway Commission.

Conveyor on Trenching Machine Improved in Many Particulars

A new conveyor has recently been brought out by the Harnischfeger Corp., Milwaukee, Wis., for use on its



gas driven excavators. Some of the improvements made upon it include the following: It can be shifted by power from one side to the other or to any intermediate point; by pulling one pin it is convertible from a cradle type to a hinged and cable supported type, which gives the advantage of raising or lowering the discharge end in case of loading trucks and under other similar circumstances; the outside frame members have been eliminated and replaced by a center frame or back-bone construction. On account of the last named improvement, dirt cannot hit the frame and land on the lower side of the belt causing wear and slippage.

Straight belt rollers have replaced the old conical ones. This new construction forms a better trough and does away with dirt guides that are used on many conveyors.

New Publications

Chrome Nickel Steel—INTERNATIONAL NICKEL CO., New York City, has issued its Bulletin No. 10, which is entitled "Chrome Nickel Steel in Special Trackwork." The bulletin is one of a series the company is publishing from time to time giving data and applications of nickel steel. In this instance it consists of an article by F. D. Hibbard, construction engineer, Milwaukee Electric Railway & Light Co. The bulletin is illustrated with line drawings and photographs of special installations where resistance to wear and rough use was necessary.

Pile Hammers — MCKIERNAN-TERRY DRILL CO., New York City, has just issued its Bulletin 37 containing 92 pages of illustrations and information on its various types of both heavy and light duty pile hammers. The illustrations and descriptions cover practically every type of work upon which pile hammers have so far been used, including subaqueous and pile pulling work. Information is given on the proper selection of pile hammers and on lubrication practice. Specification tables complete the catalog.

Waterproofing and Preservatives—SULLIVAN CO., Memphis, Tenn., has made available a folder containing a set of pamphlets each describing one of its various products. The name given to the folder is "Life Preservers for Buildings and Equipment" and such products as cement accelerators and anti-freezing compounds, paints for interior and exterior walls, stains, paints and anti-rust and waterproofing coatings for roofs, timber preservatives and coatings and various types of waterproofing and damp-proofing compounds are considered in detail.

Steel Windows—TRUSCON STEEL CO., Youngstown, Ohio, has issued catalog No. 160, describing its steel double-hung windows, in which are given drawings of construction details and general specifications as well as illustrations of the various hardware fixtures. Many buildings on which these windows have been used are shown.

Scientific Instruments—TAYLOR INSTRUMENT CO., Rochester, N. Y., has made available a 71 page catalog describing and illustrating all of its various scientific instruments, among which are included barometers, stormguides, recording thermometers, compasses, rain gages, meteorological and pressure gages.

Centrifugal Pumps—INGERSOLL-RAND CO., New York City, has issued a new and revised edition of its bulletin No. 7059 which contains information on the Cameron single-stage, double-suction, volute pump. Cross sectional illustrations of the pump in addition to descriptions and installation views, make up the bulletin.

Drafting Room Furniture — NEW YORK BLUE PRINT CO., 96 Reade St., New York City, recently issued a catalog describing its complete line of drafting room furniture and equipment such as scales, squares, irregular curves, drawing tables, filing drawers and blueprinting frames.

Business Side of Construction

Facts and Events That Affect Cost and Volume

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total Contracts
June 30, 1927	$23,322,000	$50,344,000	$73,666,000
June 23, 1927	38,636,000	34,406,000	73,042,000
June 24, 1926	19,894,000	910,613,000	1,513,096,000
Jan. 1 to date			
1927	602,483,000	910,613,000	1,513,096,000
1926	509,711,000	850,296,000	1,360,007,000

E.N.-R. Index Numbers On June 1, 1927

COST	VOLUME
205.55	299

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1925, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 18-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.80	$4.00	$3.10	$3.35	$3.87½	$3.00	$3.00	$4.00
Structural rivets, 100 lb	5.00	3.80	4.75	3.50	3.75	4.65	5.00	5.00	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	2.80	2.75	2.30@2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	48%	41%	42@53 8%	48%	37.83
Cast-iron pipe, 6 in. and over, ton	47.60	40.75	54.00	44.20	46.50	56.50	46.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.35@2.50	2.40	2.05	2.05	2.22	2.85	2.51	2.65	2.22
Gravel, ¾ in., cu.yd	1.75	2.20	2.38	1.70	1.65	1.90	1.80	1.25	1.90
Sand, cu.yd	1.00	1.40	2.00	1.65	1.25	1.00	1.40	1.25	1.35
Crushed stone, ¾ in., cu.yd	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59@61	34.00	56.00	40.50	39.25	34.25	27.00	23.00	55.00
Lime, finishing, hydrated, ton	18.20	24.50	19.00	20.00	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl	2.10@3.00	1.35	1.82	1.50	1.70	2.70	1.70	2.80	10.00
Common brick, delivered, 1,000	—17@19	12.50	14.10	12.00	13.75	9@10	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	0724	103	076	.072	.085	....	.10	.10
Hollow partition tile 4x12x12, per block	.1027	.0724	.103	076	.072	.085	108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	.89¼	— 92¼	1.10	— 87	—.96	1.10	.95	.95	1.03
Common Labor									
Common labor, union, hour	.90½	.30	.....	96	.....	.....	.60	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	....	45@.60	.31¼@.50	.50	.62½	30@.35

SUSTAINED demand, as measured by construction contracts awarded during the week, coupled with moderation in volume of production, has resulted in added firmness with upward tendencies in prices of such materials as, Douglas fir and N. C. pine two-by-fours, red cedar and composition shingles, crushed stone, hollow tile, gypsum plaster, and roofing materials.

Yellow pine two-by-fours, roofing slate, and sheathing are devoid of recent price changes in almost any locality throughout the country.

A heavier output than current demand can readily assimilate, is probably responsible for the present downward trend in the market for yellow pine and Douglas fir flooring (1-in.), No. 1 common boards (1-in.), cypress shingles, gypsum plaster board, lime, sand, window glass, c.-i. pipe, steel pipe, reinforcing bars, paint materials, structural steel, wire nails, brick, and cement. The last mentioned material declined last week in Boston as a result of keen foreign competition.

Unit Prices On New Subway Tube In Convenient Form

Complete unit prices on Route No. 1, Section 1, of the Rapid Transit R.R. in New York, have been arranged in convenient form and printed on one side of sheet and will be sent without charge to all who ask for them. Seven contractors submitted itemized bids on the more than 200 separate items that make up this big subway contract, awarded to Mason & Hanger for $22,282,309. The subway will be constructed under the East River and will be the fourth subway tube connecting Manhattan and Brooklyn.

If you want a copy of these itemized prices, write to

The Editor,
Engineering News-Record,
Tenth Avenue at 36th St.,
New York, N. Y.

Cost Elements In Construction of a Minneapolis Graded School Erected In 1925

Concrete Over Eight Per Cent of Total—Plumbing and Heating Each Seven and Steel Approximately Six

A PUBLIC school erected in Minneapolis, Minn., in 1925 cost $86,361.26, exclusive of school equipment, and the accompanying list gives the values of the sixty-three cost elements that made up this amount. The school has a ground floor and two stories, total floor area being 15,740.25 sq.ft.; cubic contents, 263,507. It is reinforced-concrete skeleton, brick and tile curtain walls. The cost elements and their proportions to the total cost are included in the following table.

From many requests received, *Engineering News-Record* believes that building-cost data are of great interest to many of its readers. Authentic data of this kind are difficult to obtain, and *News-Record* urges its readers who have such data of their own to send them in. It is not necessary to give specific projects by name: the location and a brief description of the project is sufficient to make its cost elements usable. Address: Construction News Editor, *Engineering News-Record*, Tenth Ave. at 36th St., New York, N. Y.

SIXTY-THREE COST ELEMENTS IN CONSTRUCTION OF A MINNEAPOLIS PUBLIC SCHOOL—1925

		Per Cent of Total Cost			Per Cent of Total Cost			Per Cent of Total Cost
Excavating, including trenches, tunnel, walks, leveling, etc.	$1,806	2.09	Strip filling	$254	.41	Miscellaneous hauling	$75	.09
Waterproofing concrete walls	20	.02	Painting	2,110	2.44	Gas and oil	100	.11
Plaster bond	266	.26	Glass	523	.61	Bond, contractor's	910	1.05
Concrete	7,422	8.60	Blackboards	681	.78	Spacers, setting reinforced steel	419	.48
Concrete floor finish	435	.50	Cork boards	107	.12	Setting con. toilet partition	50	.06
Concrete walks	237	.28	Plastering tile, susp., Pyro sus., extra keenes, pyro. base	4,700	5.44	Caulking and cleaning	225	.26
Cinder fill	20	.02	Beads	192	.22	Waterproofing stone	50	.06
Tile floor	519	.60	Lumber	3,796	4.39	Hauling stone	150	.17
Steel pans and setting	434	.50	Millwork	4,620	5.35	Margin, general contractor's	3,000	3.48
Tile partition, 3-in. and 6-in.	1,109	1.29	Carpenter work, rough	275	.32	Anchors	50	.06
Carpenter work, floors	363	.42	Carpenter work, finish	2,310	2.67	Insurance	150	.17
Brick, face	1,162	1.35	Paper	20	.02	Reinforcing steel	2,542.50	2.95
Brick, inside face	832	1.00	Sash weights	156	.18	Plumbing	6,167	7.15
Brick, common	2,723	3.20	Hardware, rough	115	.13	Heating	6,495	7.50
Tile partition, 5-8-12, and setting	1,620	1.88	Hardware, finish	1,573	1.83	Electric	4,160	4.80
Creosoting	40	.05	Sand	300	.35	Pipe covering	595	.69
Stone and setting	4,399	.509	Lime	400	.46	Temperature control	2,130	2.40
Wall ties	45	.05	Cement	658	.77	Ventilation	2,007	2.30
Steel and setting	5,106	5.95	Old building "miscellany"	955	1.10	Items by Bd. of Ed. shop	1,115.40	1.29
Roofing and metal	705	.82	Compensation	600	.70	Architectural cost	1,693.36	1.96
Marble and tile	334	.38	Miscellaneous labor	200	.23			
			Miscellaneous material	75	.09	Total cost exclusive of equipment	$86,361.26	100.00

Improvement Bond Issues at Record Total for Month of May

LONG term bond issues of May, 1927, mostly for state, county and municipal improvements, aggregated $207,714,709 for the entire country, according to records compiled by the *Commercial and Financial Chronicle*. This total represents the highest for the month of May, since 1892. The accompanying tabulation is taken from sales of the last week in May and the first week in June, at various points throughout the country. The issues shown are representative of the current trend in the market for bonds of this type and indicate continued activity in engineering construction of a public nature. An average interest rate of 4⅜ per cent applies on the list shown here, which it is believed, is fairly representative of the present improvement bond market for the entire country.

SOME OF THE BONDS RECENTLY SOLD FOR STATE, COUNTY AND MUNICIPAL IMPROVEMENT AND PARITY OF THE ISSUES

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased by
Maine	Bridge	$1,000,000	4	101.689	3.97	June 1, 1927	1951-78	R. L. Day & Co. and Estabrook & Co., N. Y. C.
County								
Clark, Ind	Road	45,000	4½	104.57	3.575	May 2, 1927	1928-37	Clark County State Bank
Cuyahoga, O	Roads	349,219	4½	101.24	4.22	May 21, 1927	1927-36	Assel, Goetz & Moerlein, Cincinnati, O.
Dickinson, Mich	Sanitorium	90,000	5	103.20	4.67	May 1, 1927	1928-42	Commercial Nat'l Bank of Iron Mt.
Floyd, Ia	Road	184,000	4½	100.10	4.23	May 1, 1927	1930-38	Carleton D. Beh Co., Des Moines, Ia.
Henderson, N. C	Road and bridge	950,000	4½	100.94	4.69	April 1, 1927	1938-57	Caldwell & Co., of Nashville, and others
Henry, Ky	Road and bridge	250,000	4½	101.85	4.35	July 1, 1927	1931-56	J. C. Wilson & Co. of Louisville
Richland, Lexington and Saluda, S. C	Highway	2,000,000	4¾	102.125	4.51	May 1, 1927	1929-45	Weil, Roth & Irving Co. of Cincinnati and others
Marion, Ind	Road	134,000	4½	101.35	4.23	Jan. 1, 1927	1928-37	Meyer-Kiser Bank
Spartanburg, S. C	Highway	90,000	4½	100.90	4.41	May 1, 1927	1928-47	Bankers Trust Co., New York City, and others
Berkshire, Mass	Courthouse	175,000	3¾	100.59	.....	May 31, 1927	1928-37	Shawinut Corp. of Boston
Monona, Ia	Drainage	75,300	4½	100.43	.....	May 23, 1927	.....	Geo. M. Bechtel & Co. of Davenport
Municipality								
Ada, Okla	Sewers, etc	62,500	4¾	102.15	.....	May 1, 1927	.....	Oklahoma State Bank of Ada
Anacortes, Wash	Local impv't	43,154	7	100	.....	Mar. 27, 1927	1934	Russell & Co., of Seattle
Bend, Ore	Street impv't	50,000	6	100.02	.....	May 27, 1927	.....	Carl E. Nelson & Co. of Salem
Cape May, N. J	Water-works	117,000	5	103.18	4.68	June 1, 1927	1928-57	R. M. Grant & Co. of New York City
Clayton, N. C	Water, sewer, etc	50,000	6	102	5.83	May 1, 1927	1930-61	A. T. Bell & Co. of Toledo
Deal, N. J	Municipal impv't	160,000	4½	100	.....	June 1, 1927	1929-58	Seacoast Trust Co. of Asbury Park
Dearborn, Mich	Sewer	530,000	4½	100.107	4.24	Apr. 1, 1927	1928-57	First National Bank of Dearborn
Findlay, O	Sewer, paving, etc	116,991	4¼	101.80	4.32	June 1, 1927	1928-37	W. L. Slayton & Co. of Toledo
Fitchburg, Mass	Water, hospital, paving, sewer	498,000	3¾	100.57	3.62	June 1, 1927	1928-47	R. L. Day & Co. of Boston
Fort Lauderdale, Fla	Harbor	1,880,000	6	95.10	.....	June 1927	.....	Spitzer, Rorick & Co. of New York City
Haines City, Fla	Sewer, water-works	150,000	6	95.75	6.45	May 1, 1927	1930-56	Brown-Crummer Co. of Wichita
Houston, Tex	Drainage, disposal plant, sewer, etc	3,675,000	4½	102.03	4.36	July 1, 1927	1928-57	Halsey, Stuart & Co., and others of Chicago; R. W. Pressprich & Co., of New York; Second Ward Securities Co. of Milwaukee
Indianapolis, Ind	Bridge	70,000	4½	106.27	4.04	May 1 1927	1929-51	Merchants Nat'l Bank of Indianapolis
Irvington, N. J	General Impv't	368,000	4½	101.21	4.34	June 1, 1927	1928-44	J. S. Rippel & Co. of Newark
Kansas City, Mo	Bridge	1,250,000	4½	102.39	4.03	Apr. 1, 1927	1931-55	Nat'l City Co. of New York and others
Lakeland, Fla	Water-works	300,000	5½	99.40	5.53	June 1, 1927	1937-46	Hanchett Bond Co. of Chicago, and Ryan, Sutherland & Co. of Toledo
Milwaukee, Wis	Sewer, park, etc	3,515,000	4½	103.159	4.06	July 1,1926	1928-46	Nat'l City Co. and the Old Colony Corp. of Boston; and the First Securities Co. of Manitowoc.
Pontiac, Mich	Drainage, sewage disposal, etc	330,000	4½	100.59	.....	May 31, 1927	.....	Detroit Trust Co. and Watling, Lerchen & Hays, of Detroit
Statesville, N. C	Water, street impv't	150,000	4¾	101.75	4.59	Apr. 1, 1927	1929-68	American Trust Co. of Charlotte
Washington-Suburban San. Dist., Md	Water	250,000	4½	102.56	4.335	May 1, 1927	1977	Mercantile Trust & Deposit Co. and others of Baltimore
Yonkers, N. Y	Improvement	1,580,000	4@4½	100.41	4.06	June 1, 1927	1928-42	Pulleyn & Co. and others of New York